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Pinewood Atlanta – Phase 1A
Stage 9

Fayetteville, GA

HVAC O&M Manuals

6/12/2014

General Contractor: Group VI Construction, LLC.

Mechanical Engineer: Paulson-Cheek Mechanical, Inc.

Mechanical Contractor: Paulson-Cheek Mechanical, Inc.

Section 1 Split Systems

Section 2 Rooftop Units

Section 3 Exhaust Fans

O&M SECTION SHEET

SECTION: 1
PRODUCT: SPLIT SYSTEM

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PROJECT: **Pinewood Atlanta - Phase 1A Stage 9**
LOCATION: **Fayetteville, GA**

Paulson-Cheek Mechanical, Inc.

ARCHITECT'S/ENGINEER'S STAMP

Paulson-Cheek Mechanical, Inc.

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SUPPLIER:	JCI
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[X] NO ERRORS DETECTED

[ ] CORRECT EXCEPTIONS NOTED

THIS APPROVAL OF SHOP DRAWINGS DOES NOT RELIEVE THE SUBCONTRACTOR OR VENDOR FROM THE REQUIREMENTS OF THE CONTRACT DOCUMENTS.

CHECKED BY:	William Hagler
DATE CHECKED:	06/12/14

USER'S INFORMATION MANUAL

OUTDOOR SPLIT-SYSTEM AIR CONDITIONING OR HEAT PUMP

MODELS: SINGLE PHASE & THREE PHASE

ISO 9001 Certified Quality Management System

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CONTACT INFORMATION

- Go to website at www.york.com, then click on "Contact Us" and follow the instructions.
- Contact us by mail:

Johnson Controls Unitary Products
Consumer Relations
5005 York Drive
Norman, OK 73069

The manufacturer recommends that the user read this manual and keep the manual for future reference.

SAFETY

⚠WARNING

This product must be installed and serviced by a qualified installer or service agency. Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage.

HOW YOUR SYSTEM WORKS

COOLING CYCLE

If your hand is wet and you blow on it, it feels cool because some of the moisture is evaporating and becoming a vapor. This process requires heat. The heat is being taken from your hand, so your hand feels cool.

That's what happens with an air conditioner. During the cooling cycle, your system will remove heat and humidity from your home and will transfer this heat to the outdoor air.

HEATING CYCLE (HEAT PUMPS)

During the heating cycle, your system will remove heat and humidity from the outdoor air and will transfer this heat to your home. This is possible because even 0°F outdoor air contains a great deal of heat. Remember that your heat pump doesn't generate much heat, it merely transfers it from one place to another.

System Operation

Your thermostat puts full control of the comfort level in your home at your fingertips. DO NOT switch your thermostat rapidly ON and OFF or between HEAT to COOL. This could damage your equipment. Always allow at least 5 minutes between changes.

SETTING THE THERMOSTAT

⚠CAUTION

The main power to the system must be kept ON at all times to prevent damage to the outdoor unit compressor. If necessary, the thermostat control switch should be used to turn the system OFF. Should the main power be disconnected or interrupted for 8 hours or longer, DO NOT attempt to start the system for 8 hours after the power has been restored to the outdoor unit. If heat is needed during this 8 hour period, use emergency heat.

THERMOSTATS

YOUR KEY TO COMFORT

Although thermostats may vary widely in appearance, they are all designed to perform the same basic function: to control the operation of your air conditioning or heat pump system. Regardless of size or shape, each thermostat will feature a temperature indicator; a dial, arm, or push button for selection of the desired temperature; a fan switch to choose the indoor fan operation; and a comfort switch for you to select the system mode of operation.

Only approved thermostats have been tested and are fully compatible with this equipment. *Please be aware that many different thermostats operate on batteries or "power stealing" principals. These types of thermostats can not be supported as trouble free when used with this product.*

If your system has been designed to allow both cooling and heating operation, you may have either a manual change-over type, or a programmable electronic type thermostat.

Manual change-over simply means that the comfort switch must be manually positioned every time you wish to switch from the cooling to heating or heating to cooling modes of operation.

A complete operating instruction is provided by the manufacturer for each thermostat. Familiarize yourself with its proper operation to obtain the maximum comfort with minimum energy consumption.

The computerized electronic thermostat is actually a sophisticated electronic version of a manual change-over type. This thermostat includes features which allow "set-back" temperature variations for periods of sleep, or while you are away during the day, and means energy savings for you. The thermostat also features a digital clock.

COOLING ONLY

If your air conditioning system is designed to provide cooling only (AC), with no capability for heating operation (heat pump), a two-stage cooling only thermostat, with a manual, one-position "Cool" and "Off" comfort switch is all that is required for system operation.

COOLING AND HEATING (HEAT PUMP)

If your system has been designed to allow both cooling and heating operation, you may have either a manual change-over type, or a programmable electronic type thermostat with 2-stages of cooling and 2-stages of heat.

MANUAL CHANGE-OVER

Manual change-over simply means that the comfort switch must be manually positioned every time you wish to switch from the cooling to heating or heating to cooling modes of operation.

PROGRAMMABLE ELECTRONIC THERMOSTATS

The computerized electronic thermostat is actually a sophisticated electronic version of a manual change-over type. This thermostat includes features which allow “set-back” temperature variations for periods of sleep, or while you are away during the day, and means energy savings for you. The thermostat also features a digital clock.

FAN OPERATION SELECTION

A multi-position fan switch allows you to choose the type of fan operation of the indoor fan.

AUTO

With the thermostat fan switch set to “AUTO”, the fan will run intermittently as required for either heating or cooling. This position will provide the lowest operating cost. If you purchased one of our thermostats, they have an Intelligent fan mode which continually circulates the air during occupied modes or when you are at home, and can cycle the fan during unoccupied mode or during the night while you sleep to further conserve energy.

ON

CONTINUOUS FAN OPERATION: With the thermostat fan switch set to “ON”, the indoor fan will not shut off. However, the cooling (AC) or heating (heat pump) systems will still operate as required by room temperatures. This provides continuous air filtering and more even temperature distribution to all conditioned spaces.

FAN ONLY OPERATION: On moderate days, usually during spring and fall, when neither heating nor cooling is required, you may want to run only the fan to ventilate, circulate and filter the air in your home or building. Set the comfort control switch to “OFF” and the fan switch to “ON”. Be sure to return the switches to their original positions for normal operation.

START-UP

The maximum and minimum conditions for operation must be observed to assure a system that will give maximum performance with minimum service.

TABLE 1: Application Limitations

Air Temperature at Outdoor Coil, °F				Air Temperature at Indoor Coil, °F			
Min.		Max.		Min.		Max.	
DB Cool	DB Heat	DB Cool	DB Heat	WB Cool	DB Heat	WB Cool	DB Heat
60	-10	115	75	57	50[1]	72	80

1. Operation below this temperature is permissible for a short period of time, during morning warm-up.

The comfort control switch is assumed to be in the “OFF” position. If the main power supply to the outdoor and indoor units is off, turn the appropriate disconnects to the “ON” position. Place the system into operation as follows:

1. Set temperature adjustment to the desired temperature on your thermostat.

COOLING - The higher the setting, the lower the amount of energy consumed. Federal Guidelines recommend a setting of 78 °F.

HEATING - The lower the setting, the lower the amount of energy consumed. Federal guidelines recommend a setting of 65 °F or lower.

NOTICE

If your cooling and heating temperature adjustments are separate, be sure to set both.

2. After considering “Fan Operation Selection” above, select and set the fan operation mode you desire.
3. Move the comfort control switch to the desired mode of operation (Cooling or Heating) found on your particular thermostat.

POWER FAILURE

When accidents, wind storms, etc. disrupt electrical power supply to your house, switch thermostat to “OFF” position.

SYSTEM OPERATION

MANUAL CHANGE-OVER THERMOSTAT

COOLING YOUR HOME: With the comfort control switch in the “COOL” position, the system will operate as follows: When the indoor temperature rises above the level indicated by the temperature adjustment setting, the system will start. The outdoor unit will operate and the indoor fan will circulate the cooled, filtered air. When the room temperature is lowered to the setting selected, the system will shut off.

HEATING YOUR HOME: If your system includes a heating unit and the comfort control switch is in the “HEAT” position, the system will operate as follows: When the indoor temperature drops below the level indicated by the temperature adjustment setting, the system will start. The heating system will operate and the indoor fan will circulate the filtered air. When the room temperature rises to the setting selected, the system will shut off. Whether heating or cooling, the fan will continue to operate if the fan switch was set in the “ON or Intelligent” position. The “AUTO” setting on the fan switch will allow the fan to shut off when your system does.

ELECTRONIC THERMOSTAT

The computerized electronic thermostat, when programmed, will function automatically to operate the system as follows: When the indoor temperature rises above the higher (COOL) setting, the outdoor unit will operate and the indoor fan will circulate the cooled, filtered air. When the room temperature is lowered to the selected level, the system will shut off. The indoor fan will either shut off or run continuously, depending upon your choice of fan switch setting. When the indoor temperature drops below the lower (HEAT) setting, the heating system will operate, and the indoor fan will circulate the heated, filtered air. When the indoor temperature rises to the selected setting, the system will shut off. The indoor fan will either shut off or run continuously, depending upon your choice of fan switch setting.

TO MAXIMIZE OPERATING EFFICIENCY

HEATING CONSERVATION

For the most efficient operation, keep storm windows and doors closed all year long. They not only help insulate against heat and cold, but they also keep out dirt, pollen, and noise.

Closing drapes at night, keeping fireplace dampers closed when not in use, and running exhaust fans only when necessary will help you to retain the air you have already paid to heat.

Keep lamps, televisions, or other heat producing sources away from the thermostat. The thermostat will sense this extra heat and will not be able to maintain the inside temperature to the desired comfort level.

COOLING CONSERVATION

To comfortably cool your home, your air conditioner must remove both heat and humidity. Don't turn your system off even though you will be away all day. On a hot day, your system may have to operate between 8 to 12 hours to reduce the temperature in your home to a normal comfort level.

Keep windows closed after sundown. While the outdoor temperature at night may be lower than indoors, the air is generally loaded with moisture which is soaked up by furniture, carpets, and fabrics. This moisture must be removed when you restart your system.

The hotter the outside temperature, the greater the load on your system. Therefore do not be alarmed when your system continues to run after the sun has set on a hot day. Heat is stored in your outside walls during the day and will continue to flow into your home for several hours after sunset.

Use your kitchen exhaust fan when cooking. One surface burner on "HIGH" requires one ton of cooling. Turn on your bathroom exhaust fan while showering to remove humidity. However, exhaust fans should not be run excessively. It would decrease efficiency by removing conditioned air.

You can also help your system in the summer by closing drapes or blinds and by lowering awnings on windows that get direct sunlight.

CARE OF SYSTEM

It is strongly recommended that regular periodic preventative maintenance be performed on this equipment. The person most familiar with the equipment in your H.V.A.C. system is a dealer. The dealer can ensure your maintenance program meets the conditions of the Warranty", maximize the efficiency of the equipment, and service your unit within the federally mandated guidelines with regard to unlawful discharge of refrigerants into the atmosphere.

COIL CARE

Keep the outdoor unit free of foliage, grass clippings, leaves, paper, and any other material which could restrict the proper air flow in and out of the unit. The coil may be vacuumed to remove any debris from between the fins. If the coil becomes excessively dirty, turn the main disconnect switch to "Off" and wash the coil with your garden hose. Avoid getting water into the fan motor and control box. Flush dirt from base pan after cleaning the coil.

SERVICE CALLS

There are a few instances where the user can avoid unnecessary service calls. If unit stops functioning properly check the following items before calling your servicing dealer:

1. Indoor section for dirty filter.
2. Outdoor section for leaf or debris blockage. Eliminate problem, turn off the thermostat for 10 seconds and attempt start. Wait 5 minutes. If system does not start, call your servicing dealer.

⚠WARNING

Your system contains environmentally friendly refrigerant R-410A, which operates at high pressures. You may be in danger if you try to make an attempt to repair your unit. Please contact your local dealer.

FILTER CARE

Inspect the air filter(s) at least once a month. If they are dirty, wash reusable filters with a mild detergent per manufacturer's recommendations. Replace disposable filters with new filters. Install the clean filters with "air flow" arrow in the same direction as the air flow in your duct. Filters should be clean to assure maximum efficiency and adequate air circulation.

CLEARANCES

The minimum clearances shown below must be maintained should any patio or yard improvements be done around the outdoor unit.

- 10" Clearance Coil Area
- 60" Overhead Clearance
- 18" to 24" is the minimum service panel access depending on model. Refer to the installation manual for details.
- 24" Unit to Unit Distance

PARTS INFORMATION

Replacement parts are available from local contractor/dealer.

EXTENDED WARRANTY

Special warranty packages (called York Care Performance Promise) are available through your contractor. These packages reduce the potential cost of service calls following the first year of operation on your cooling (or heating/cooling) system.

SOME EFFICIENCY DO'S & DON'TS

DON'T heat or cool unused household area. Reduce supply and return air flow to a minimum in areas which are not living spaces (storage rooms, garages, basements, etc).

DON'T be a "thermostat jiggler". Moving your thermostat setting will not make your system heat or cool any faster. Adjust your thermostat to a comfortable setting and leave it there.

DON'T restrict air circulation. Placing furniture, rugs, etc. in such a way that they interfere with air vents will make your system work harder to achieve a comfortable temperature level. This requires more energy, which means greater cost to you.

DON'T locate lamps or other heat-producing appliances (radios, TV's, heaters, etc.) near your thermostat. The heat from these items will give your thermostat "false information" about the temperature in the room.

DO select a comfortable thermostat setting, but keep in mind that moderation in temperature selection will save energy.

DO turn on your kitchen exhaust fan when cooking and your bathroom exhaust fan when showering. Also, make sure your clothes dryer is properly vented. If these items are neglected, an excess heat and humidity condition may be created, causing your air conditioning system to run longer.

DO set your thermostat a few degrees lower than normal several hours before entertaining a large group of people in a relatively small area. People give off a considerable amount of heat and moisture in a closed area.

DO keep drapes and venetian blinds closed when practical. These items provide insulation against heat loss/gain.

DO contact a qualified service person to make repairs or adjustments to your system. He has been trained to perform this service.

Limited Warranty

Johnson Controls Unitary Products (hereinafter "Company") warrants this product to be free from defects in factory workmanship and material under normal use and service and will, at its option, repair or replace any parts, without charge, subject to the exclusions below, that prove to have such defects according to the terms outlined on this warranty. This warranty covers only the equipment described by the Product Model Number and Serial Number on the equipment or listed on the Warranty Registration Card and applies only to products installed in the United States or Canada.

FOR WARRANTY SERVICE OR REPAIR: Contact the installer or a Company dealer. You may find the installer's name on this page or on the equipment. For help finding a servicing dealer, contact: Johnson Controls Unitary Products, Consumer Relations, 5005 York Drive, Norman, OK 73069. Or, by phone 877-874-7378. All warranty service or repair will be performed during regular business hours, Monday through Friday 9:00am-5:00pm.

Product Model Number: _____ Installation Date: _____

Unit Serial Number: _____ Installing Dealer: _____

FOR PRODUCT REGISTRATION: For your benefit and protection, return the Warranty Registration Card to Company promptly after installation. This will initiate the warranty period and allow us to contact you, should it become necessary. This warranty extends only to the original consumer purchaser and is nontransferable. For this warranty to apply, the product must be installed according to Company recommendations and specifications, and in accordance with all local, state, and national codes; and the product must not be removed from its place of original installation. The warranty period for repair or replacement parts provided hereunder shall not extend beyond the warranty period stated below. In the absence of a recorded Warranty Registration Card, the warranty period will begin upon product shipment from Company. If you are unaware of the date the warranty became effective, contact Company at 877-874-7378 or visit www.upgproductregistration.com. You can register your product online at www.upgproductregistration.com or by returning the Warranty Registration Card on the back page of this packet. The warranty period in years, depending on the part and the claimant, is as shown in the chart below.

CONDENSING UNITS			
CONDENSING UNITS	**COMPRESSOR**	**PARTS**	**CONDENSER COIL**
R-410A Models: GCGD, GHGD R-22 Dry Ship Models: GCGD, GHGD	5	5	5 #
R-410A Models: T(C,H)GD	5 or 10††	5 or 10†	5 #
R-410A Models: T(C,H)JD*, Y(C,H)JD*, (Y,T)HJR, T(C,H)GF, T(C,H)JF, Y(C,H)JF, TCHD*	10	5 or 10†	5 # (Except TCHD models which are NA)
R-410A Models: (C,Y)ZF (C,Y)ZH, AC(6,8)B, AL(6,8)B, HC(6,8)B, HL(6,8)B	10 or Lifetime 1	5 or 10†	NA

* All 3 phase models (with 43/44 voltage codes) have 5-year compressor and 1-year parts warranty and are not eligible for 10-year parts warranty.

To qualify for the E-Coat Coil warranty the homeowner must register online at www.upgproductregistration.com within 90 days of installation for replacement units or within 90 days of closing for new home construction. In some states, registration is not required, but proof of installation is required. The warranty for models equipped with E-Coat Coil option only covers condenser coil failures due to corrosion. The warranty provides the homeowner with the option of replacement of either a) the condenser coil, or b) the condensing unit, at the discretion of the servicing dealer.

† To qualify for extended 10-year parts and compressor warranty††, the unit must be registered online at www.upgproductregistration.com within 90 days of installation for replacement or 90 days of closing for new home construction. In some states, registration is not required, but proof of installation is required to qualify for 10 year parts warranty. Guardian Brand products have 5-year compressor and 5-year parts warranty and are not eligible for10-year parts warranty.

1. **Lifetime Compressor Warranty requires the following:** Unit registration must occur within 90 days of installation date on www.upgproductregistration.com website. The warranty is non-transferrable and is limited to the original owner.

Company strongly recommends regular periodic preventative maintenance on this equipment. The person most familiar with the equipment in your HVAC system is a Company dealer. The Company dealer can ensure your maintenance program meets the "Company Warranty" conditions, maximize the equipment efficiency, and service your unit within the mandated guidelines with regard to unlawful discharge of refrigerants into the atmosphere.

EXCLUSIONS

This warranty does not cover any:

1. Shipping, labor, or material charges or damages resulting from transportation, installation, or servicing.
2. Damages resulting from accident, abuse, fire, flood, alteration, or acts of God. Tampering, altering, defacing or removing the product serial number will serve to void this warranty.
3. Damages resulting from use of the product in a corrosive atmosphere.
4. Damages resulting from inadequacy or interruption of electrical service or fuel supply, improper voltage conditions, blown fuses, or other like damages.
5. Cleaning or replacement of filters or damages resulting from operation with inadequate supply of air or water.
6. Damages resulting from failure to properly and regularly clean air and/or water side of condenser and evaporator.
7. Damages resulting from: (I) freezing of condenser water or condensate; (II) inadequate or interrupted water supply; (III) use of corrosive water; (IV) fouling or restriction of the water circuit by foreign material or like causes.
8. Damages resulting from use of components or accessories not approved by Company (vent dampers, etc.).
9. Increase in fuel or electric cost.

This warranty is in lieu of all other warranties, expressed or implied, including the implied warranties of merchantability and fitness for a particular purpose. Some states do not allow the disclaimer of implied warranty, so that the above disclaimer may not apply to you. Some states only allow a partial limitation on implied warranties to limit the duration of implied warranties to the duration of the express warranty. In such states, the duration of implied warranties is hereby expressly limited to the duration of the express warranty on the face hereof. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you. In no event, whether as a result of breach of warranty or contract, tort (including negligence), strict liability, or otherwise, shall Company be liable for special, incidental, or consequential damages, including but not limited to loss of use of the equipment or associated equipment, lost revenues or profits, cost of substitute equipment or cost of fuel or electricity.

The above limitations shall inure to the benefit of Company's suppliers and subcontractors. The above limitation on consequential damages shall not apply to injuries to persons in the case of consumer goods. Company does not assume, or authorize any other person to assume for Company, any other liability for the sale of this product. Some states do not allow the exclusion or limitation of incidental or consequently damages, so the above limitation may not apply to you. This warranty gives you specific legal rights. You may also have other rights which vary from state to state.

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York International Corp.
5005 York Drive
Norman, OK 73069

INSTALLATION MANUAL

SINGLE PIECE, 3 POSITION AIR HANDLERS

MODELS: AHR / AHE SERIES

AHRI CERTIFIED www.ahridirectory.org

C SA US

ISO 9001 REGISTRATION
ISO 9001
Certified Quality
Management System

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SECTION I: GENERAL

The AHR/AHE single piece air handler provides the flexibility for installation in any upflow or horizontal application.

These versatile models may be used for cooling or heat pump operation with or without electric heat.

A BRAND LABEL (available from Distribution) may be applied to the center of the blower access panel.

The unit can be positioned for bottom return air in the upflow position, and right or left return in the horizontal position.

Top and side power wiring and control wiring, accessible screw terminals for control wiring, easy to install drain connections and electric heaters all combine to make the installation easy, and minimize installation cost.

SECTION II: SAFETY

This is a safety alert symbol. When you see this symbol on labels or in manuals, be alert to the potential for personal injury.

Understand and pay particular attention to the signal words **DANGER**, **WARNING**, or **CAUTION**.

DANGER indicates an **imminently** hazardous situation, which, if not avoided, **will result in death or serious injury**.

WARNING indicates a **potentially** hazardous situation, which, if not avoided, **could result in death or serious injury**.

CAUTION indicates a potentially hazardous situation, which, if not avoided **may result in minor or moderate injury.** It is also used to alert against unsafe practices and hazards involving only property damage.

⚠WARNING

Improper installation may create a condition where the operation of the product could cause personal injury or property damage.

Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage. Refer to this manual for assistance or for additional information, consult a qualified contractor, installer or service agency.

⚠CAUTION

This product must be installed in strict compliance with the installation instructions and any applicable local, state, and national codes including, but not limited to building, electrical, and mechanical codes.

⚠WARNING

FIRE OR ELECTRICAL HAZARD

Failure to follow the safety warnings exactly could result in serious injury, death or property damage. A fire or electrical hazard may result causing property damage, personal injury or loss of life.

1. Install this air handler only in a location and position as specified in SECTION III of these instructions.
2. Always install the air handler to operate within the air handler's intended maximum outlet air temperature. Only connect the air handler to a duct system which has an external static pressure within the allowable range, as specified on the air handler rating plate.
3. When an air handler is installed so that supply ducts carry air circulated by the air handler to areas outside the space containing the air handler, the return air shall also be handled by duct(s) sealed to the air handler casing and terminating in the space to be cooled/heated.
4. The air handler is not to be used for temporary heating of buildings or structures under construction.
5. The size of the unit should be based on an acceptable heat loss or gain calculation for the structure. ACCA, Manual J or other approved methods may be used.

SAFETY REQUIREMENTS

1. This air handler should be installed in accordance with all national and local building/safety codes and requirements, local plumbing or wastewater codes, and other applicable codes.
2. Refer to the unit rating plate for the air handler model number, and then see the dimensions page of this instruction for supply air plenum dimensions in Figure 5. The plenum must be installed according to the instructions.
3. Provide clearances from combustible materials as listed under Clearances.
4. Provide clearances for servicing ensuring that service access is allowed for electric heaters and blower.
5. Failure to carefully read and follow all instructions in this manual can result in air handler malfunction, death, personal injury and/or property damage.
6. Check the rating plate and power supply to be sure that the electrical characteristics match.
7. Air handler shall be installed so the electrical components are protected from water.
8. Installing and servicing heating/cooling equipment can be hazardous due to the electrical components. Only trained and qualified personnel should install, repair, or service heating/cooling equipment. Untrained service personnel can perform basic maintenance functions such as cleaning and replacing the air filters. When working on heating/cooling equipment, observe precautions in the manuals and on the labels attached to the unit and other safety precautions that may apply.
9. These instructions cover minimum requirements and conform to existing national standards and safety codes. In some instances these instructions exceed certain local codes and ordinances, especially those who have not kept up with changing residential and non-HUD modular home construction practices. These instructions are required as a minimum for a safe installation.

INSPECTION

As soon as a unit is received, it should be inspected for possible damage during transit. If damage is evident, the extent of the damage should be noted on the carrier's freight bill. A separate request for inspection by the carrier's agent should be made in writing. Also, before installation the unit should be checked for screws or bolts, which may have loosened in transit. There are no shipping or spacer brackets which need to be removed.

Also check to be sure all accessories such as heater kits, suspension kits, and coils are available. Installation of these accessories or field conversion of the unit should be accomplished before setting the unit in place or connecting any wiring, electric heat, ducts or piping.

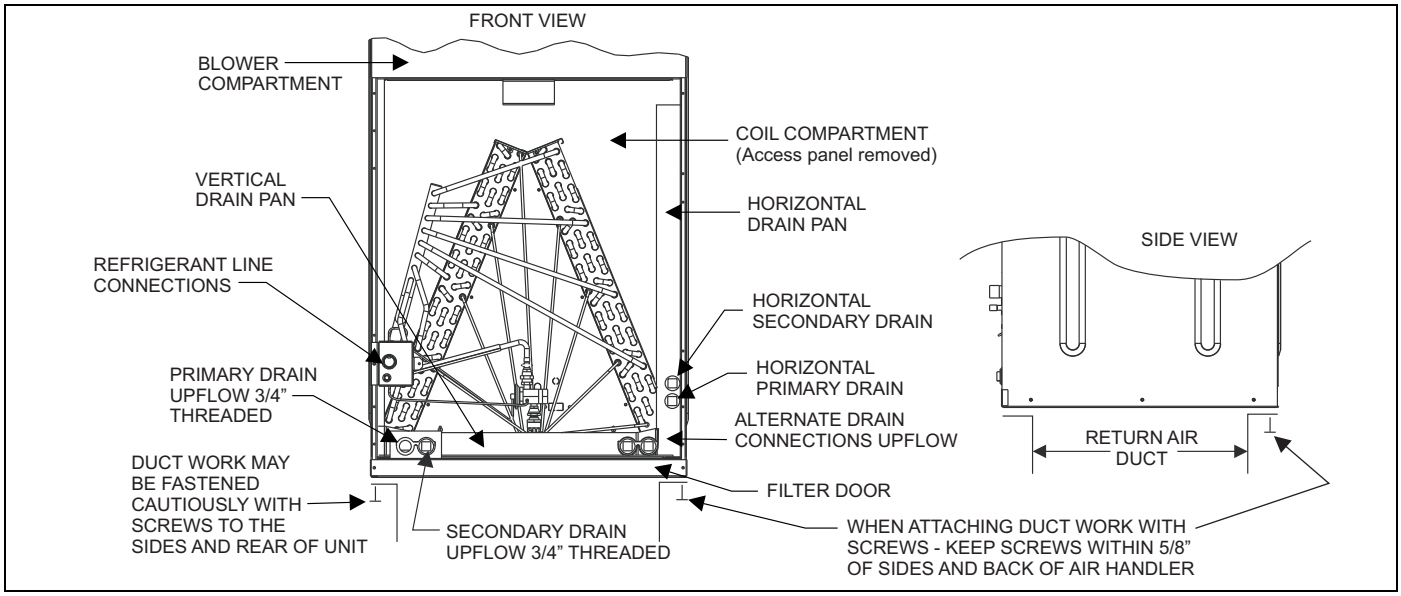
LIMITATIONS

These units must be wired and installed in accordance with all national and local safety codes. Voltage limits are as follows:

Air Handler Voltage	Voltage code	Normal Operating [1] Voltage Range
208/230-1-60	06	187-253

1. Rated in accordance with ARI Standard 110, utilization range "A". Airflow must be within the minimum and maximum limits approved for electric heat, evaporator coils and outdoor units.

Entering Air Temperature Limits			
Wet Bulb Temp. °F		Dry Bulb Temp. °F	
Min.	Max.	Min.	Max.
57	72	65	95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HORIZONTAL PRIMARY DRAIN
PRIMARY DRAIN UPFLOW 3/4" THREADED
ALTERNATE DRAIN CONNECTIONS UPFLOW
DUCT WORK MAY BE FASTENED CAUTIOUSLY WITH SCREWS TO THE SIDES AND REAR OF UNIT
FILTER DOOR
SECONDARY DRAIN UPFLOW 3/4" THREADED
WHEN ATTACHING DUCT WORK WITH SCREWS - KEEP SCREWS WITHIN 5/8" OF SIDES AND BACK OF AIR HANDLER
SIDE VIEW
RETURN AIR DUCT

FIGURE 1: Return Duct Attachment & Component Location

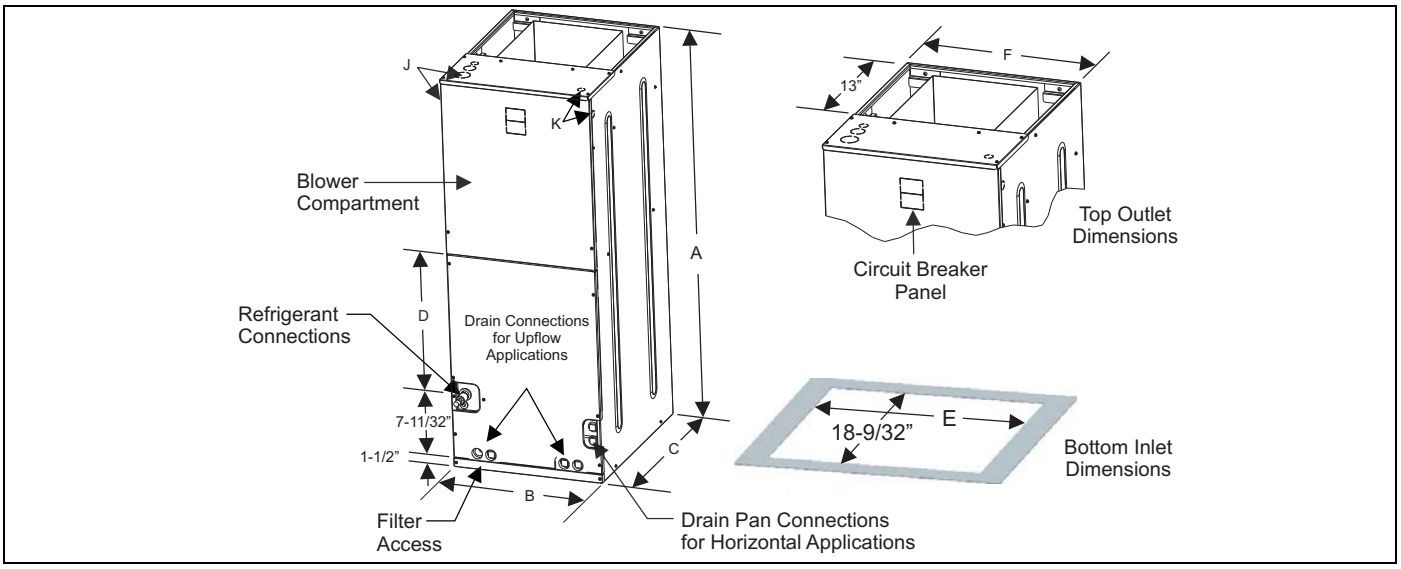


FIGURE 2: Dimensions & Duct Connection Dimensions

TABLE 1: Dimensions

Models	Dimensions						Wiring Knockouts		Refrigerant Connections Line Size	
	A	B	C	D	E	F	J	K		
	Height	Width	Depth				Power	Control	Liquid	Vapor
AHR18B/AHE18B	46"	17 1/2"	21 1/2"	16 1/2"	13-29/32"	16 1/2"	7/8" (1/2")[1] 1-3/8"(1") 1-23/32" (1-1/4")	7/8" (1/2")	3/8"	3/4"
AHE22B	46"	17 1/2"		16 1/2"	13-29/32"	16 1/2"				
AHR24B/AHE24B	46"	17 1/2"		16 1/2"	13-29/32"	16 1/2"				
AHR30B/AHE30B	46"	17 1/2"		16 1/2"	13-29/32"	16 1/2"				
AHR36B	46"	17 1/2"		16 1/2"	13-29/32"	16 1/2"				
AHE34C	52"	21"		21 1/2"	17-13/32"	20"				
AHR42C/AHE36C	52"	21"		21 1/2"	17-13/32"	20"				
AHR48D/AHE42D/AHE48D	57"	24 1/2"		26"	20-29/32"	23-1/2"				7/8"
AHR60D/AHE60D	57"	24 1/2"		26"	20-29/32"	23-1/2"				

1. Actual size (conduit size).

SECTION III: UNIT INSTALLATION

CLEARANCES

Clearances must be taken into consideration, and provided for as follows:

1. Refrigerant piping and connections - minimum 12" recommended.
2. Maintenance and servicing access - minimum 36" from front of unit recommended for blower motor / coil replacement.
3. Condensate drain lines routed to clear filter and panel access.
4. Filter removal - minimum 36" recommended.
5. The ductwork and plenum connected to this unit are designed for zero clearance to combustible materials.
6. A combustible floor base accessory is available for downflow applications of this unit, if required by local code.

LOCATION

Location is usually predetermined. Check with owner's or dealer's installation plans. If location has not been decided, consider the following in choosing a suitable location:

1. Select a location with adequate structural support, space for service access, clearance for air return and supply duct connections.
2. Use hanging brackets to wall mount this single piece air handler unit, is not recommended.
3. Normal operating sound levels may be objectionable if the air handler is placed directly over some rooms such as bedrooms, study, etc.
4. Select a location that will permit installation of condensate line to an open drain or outdoors allowing condensate to drain away from structure.

NOTICE

The primary and secondary drain line must be trapped to allow proper drainage of condensate water. If the secondary drain line is not used, it must be capped.

The coil is provided with a secondary drain. It should be piped to a location that will give the occupant a visual warning that the primary drain is clogged. If the secondary drain is not used it must be capped.

5. When an evaporator coil is installed in an attic or above a finished ceiling, an auxiliary drain pan should be provided under the air handler as is specified by most local building codes.
6. Proper electrical supply must be available.
7. If unit is located in an area of high humidity (i.e. an unconditioned garage or attic), nuisance sweating of casing may occur. On these installations, unit duct connections and other openings should be properly sealed, and a wrap of 2" fiberglass insulation with vinyl vapor barrier should be used.

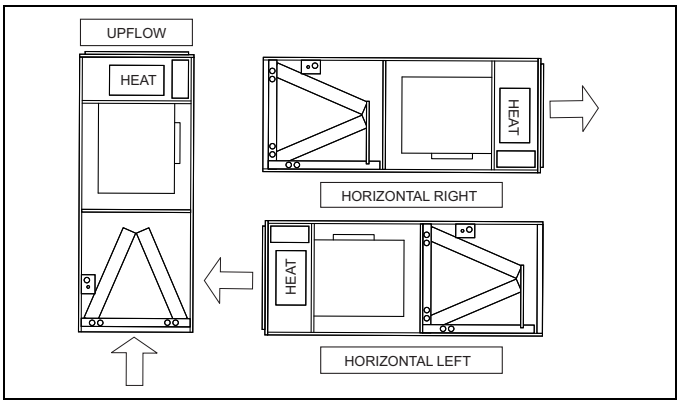


FIGURE 3: Typical Installation

HORIZONTAL CONVERSION

These air handler units are supplied ready to be installed in a upflow and right hand horizontal position. If unit requires left hand positioning, the unit must have the coil assembly repositioned.

NOTICE

For both horizontal applications, the condensate deflector should be positioned as shown in Figure 5.

1. Remove blower, coil, and filter access panels.

NOTICE

Conversion must be made before brazing the refrigerant connections to the coil.

For horizontal left installations, follow steps 2 - 8.

2. Remove tubing connection panel.
3. Slide coil assembly out of air handler.
4. Rotate cabinet 180º so blower outlet is facing down.
5. Re-install coil assembly on coil support bracket.
6. Re-attach tubing connection panel.
7. For horizontal applications, rotate air handler 90º into desired orientation.
8. Re-position drain plugs as necessary based on air handler orientation.
9. Re-position and replace access panels.

SUCTION FEEDER TUBECONDENSATE DEFLECTOR

UPFLOW

No action required. See Figure 6.

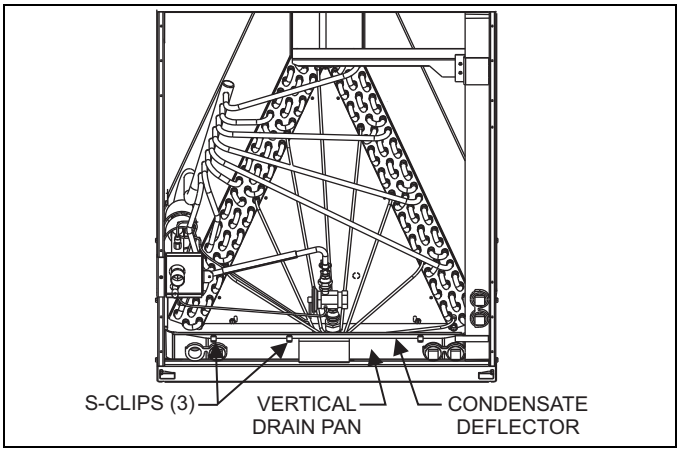


FIGURE 4: Condensate Deflector on Vertical Drain Pan

HORIZONTAL LEFT OR RIGHT

Use an appropriate tool to pry out water deflector with two or three s-clips from the vertical drain pan, see Figure 4. Relocate the deflector with s-clips on the Horizontal Drain Pan lined up to the coil support bracket. See Figure 2. This positions the deflector below the feeder tubes to channel the condensate to the drain pan.

NOTICE

The condensate deflector should be installed in the s-clip section which is inside the drain pan edge. See Figure 8.

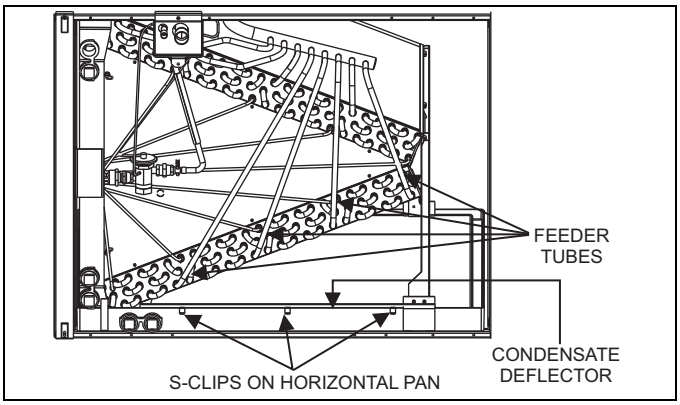


FIGURE 5: Condensate Deflector on Horizontal Drain Pan Edge

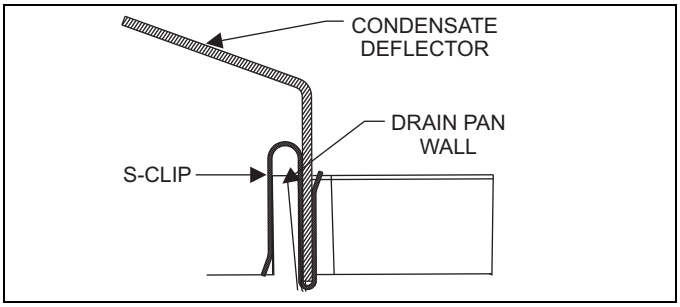


FIGURE 6: S-Clip Installation

DUCT FLANGES

Four flanges are provided to attach ductwork to the furnace. These flanges are rotated down for shipment. In order to use the flanges, remove the screw holding an individual flange, rotate the flange so it is in the upward position and reinstall the screw then repeat this for all 4 flanges.

If the flanges are not used, they must remain in the rotated down position as shipped.

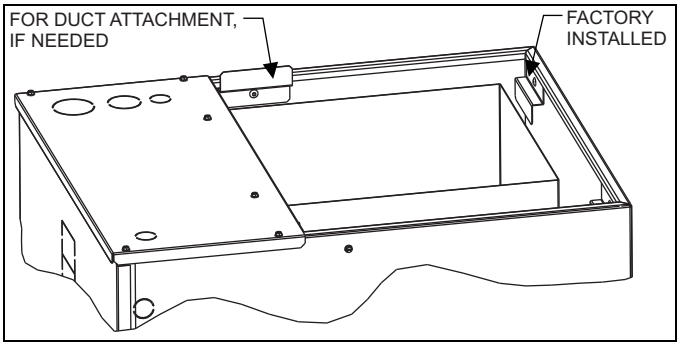


FIGURE 7: Duct Attachment

DUCT CONNECTIONS

⚠WARNING

Use 1/2" screws to connect ductwork to bottom of unit. Longer screws will pierce the drain pan and cause leakage. If pilot holes are drilled, drill only though field duct and unit bottom flange.

Air supply and return may be handled in one of several ways best suited to the installation. See Figure 5 for dimensions for duct inlet and outlet connections.

The vast majority of problems encountered with combination heating and cooling systems can be linked to improperly designed or installed duct systems. It is therefore highly important to the success of an installation that the duct system be properly designed and installed.

Use flexible duct collars to minimize the transmission of vibration/noise into the conditioned space. If electric heat is used, non-flammable material must be used.

Where return air duct is short, or where sound may be a problem, sound absorbing glass fiber should be used inside the duct. Insulation of ductwork is a must where it runs through an unheated space during the heating season or through an uncooled space during the cooling season. The use of a vapor barrier is recommended to prevent absorption of moisture from the surrounding air into the insulation.

The supply air duct should be properly sized by use of a transition to match unit opening. All ducts should be suspended using flexible hangers and never fastened directly to the structure. This unit is not designed for non-ducted (freeblow) applications. Size outlet plenum or transition to discharge opening sizes shown in Figure 5.

Ductwork should be fabricated and installed in accordance with local and/or national codes. This includes the standards of the National Fire Protection Association for Installation of Air-Conditioning and Ventilating Systems, NFPA No. 90B.

DUCTWORK TRANSITION

Ductwork that is not designed to match the supply air opening can cause turbulence inside the plenum box. This turbulence can change the air flow patterns across the heat kit limit switch. If the factory suggested transition can not be fabricated, it is recommended a block off plate (approximately 8” in height and running the full width of the plenum) be attached to the supply opening Please refer to Figure 9 as a visual aid. The use of this block off plate will keep better air circulation across the limit switch.

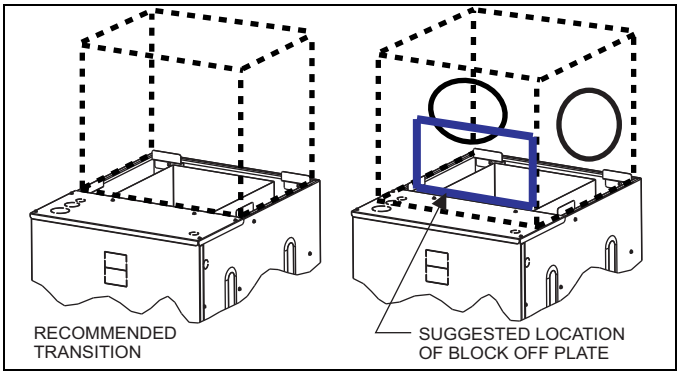


FIGURE 8: Ductwork Transition

AIR FILTERS

Air filters must be field supplied. A 1" filter access rack has been built into the unit. See Figure 5. Remove filter access cover shown. Install proper size filter. Standard 1" size permanent or throw away filter may be used, or, permanent washable filters are available using model numbers: 1PF0601, 602 or 603BK. See Table 2 for filter size.

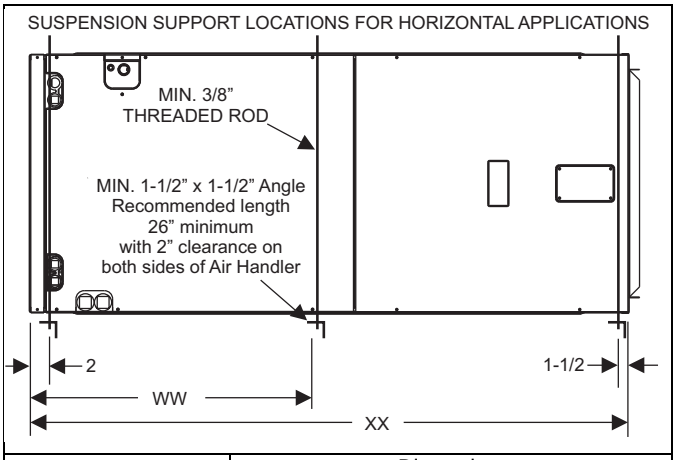
⚠CAUTION

Equipment should never be operated without filters.

HORIZONTAL SUSPENSION

For suspension of these units in horizontal applications, it is recommended to use angle steel support brackets with threaded rods, supporting the units from the bottom, at the locations shown in Figure 10.

When an evaporator coil is installed in an attic or above a finished ceiling, an auxiliary drain pan should be provided under the air handler as is specified by most local building codes.



Units (Nominal Tons)	Dimension	
	WW	XX
AHR		
18, 24, 30, 36	20	46
42	24	52
48, 60	28	57
AHE		
18, 22, 24, 30	20	46
34, 36	24	52
42, 48, 60	28	57

FIGURE 9: Typical Horizontal Installation

TXV METERING DEVICES

If the model number is of the following model series:
3X, the coil will require a R22 or R410A Orifice or TXV to be installed in the field. Refer to installation manual with TXV kit. It is recommended to install the TXV kit prior to brazing line sets.

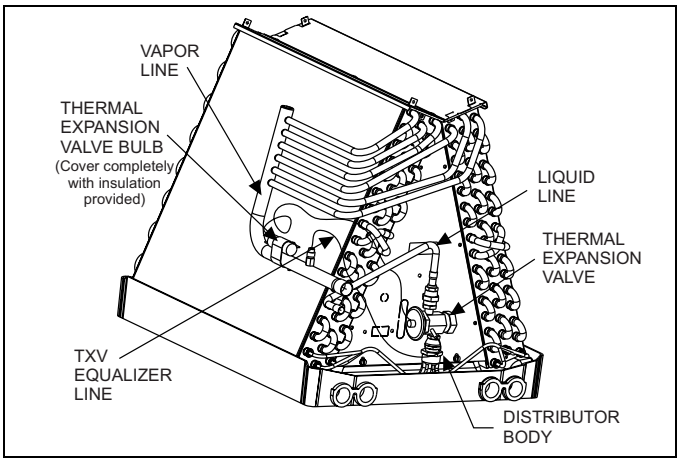


FIGURE 10: TXV

Please refer to Outdoor Unit Tech Guide to verify which TXV is installed in this coil and that this is a valid system match for the AC or HP unit installed.

The temperature sensing bulb is attached to the coil suction header line.

NOTICE

For models that have factory installed TXV's, take caution not to apply high temperatures to the TXV assembly or equalizer line while brazing.

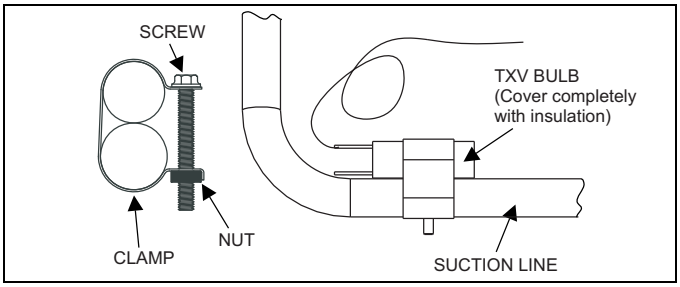


FIGURE 11: Proper Bulb Location

⚠CAUTION

COIL UNDER PRESSURE.

Relieve pressure by depressing schrader core. Coil may have factory installed TXV or may require orifice or TXV to be added. See outdoor unit documentation for correct orifice or TXV to be used. Refer to coil nameplate for orifice or TXV identification for this unit.

NOTICE

The coil should be open to the air for no more than 2 minutes to keep moisture and contaminates from entering the system. If the coil cannot be brazed into the refrigeration system in that time, the ends should be temporarily closed or plugged. For a short term delay, use masking tape over the ends of the copper tubing to close the tube to the air. For a longer term delay, use plugs or caps. There is no need to purge the coil if this procedure is followed.

REFRIGERANT LINE CONNECTION

⚠CAUTION

Dry nitrogen should always be supplied through the tubing while it is being brazed, because the temperature required is high enough to cause oxidation of the copper unless an inert atmosphere is provided. The flow of dry nitrogen should continue until the joint has cooled. Always use a pressure regulator and safety valve to insure that only low pressure dry nitrogen is introduced into the tubing. Only a small flow is necessary to displace air and prevent oxidation.

Connect lines as follows:

NOTICE

Route the refrigerant lines to the coil in a manner that will not obstruct service access to the coil, air handling system, or filter.

1. Suction and liquid line connections are made outside the cabinet. Leave the tubing connection panel attached to the cabinet with the tubes protruding through it. Coil access panel should be removed for brazing. The lines are swedged to receive the field line set tubes.
2. Remove the heat shield from the Customer Packet, soak in water, and install over coil tubing to prevent overheating of cabinet.
3. Wrap a water soaked rag around the coil connection tubes inside the cabinet to avoid damaging the TXV bulb.
4. Remove grommets where tubes exit the cabinet to prevent burning them during brazing.
5. Purge refrigerant lines with dry nitrogen.
6. Braze the suction and liquid lines. Suction line must be insulated.
7. Remove the heat shield.
8. Re-attach the grommets to the lines carefully to prevent air leakage.
9. Attach the coil access panel to the cabinet.

NOTICE

***ALWAYS** evacuate the coil and line. Set tubing to 500 microns before opening outdoor unit service valves.*

Refer to Outdoor unit Installation Manual for evacuation, leak check and charging instructions.

Lines should be sound isolated by using appropriate hangers or strapping.

All evaporator coil connections are copper-to-copper and should be brazed with a phosphorous-copper alloy material such as Silfos-5 or equivalent. DO NOT use soft solder.

DRAIN CONNECTIONS

All drain lines should be trapped a minimum of three inches, should be pitched away from unit drain pan and should be no smaller than the coil drain connection.

⚠CAUTION

Threaded drain connection should be hand-tightened, plus no more than 1/16 turn.

Route the drain line so that it does not interfere with accessibility to the coil, air handling system or filter and will not be exposed to freezing temperatures. See Figures 2 and 4 for drain connection locations.

⚠CAUTION

When the coil is installed in an attic or above a finished ceiling, an auxiliary drain pan should be provided under the coil if specified by local building codes. When this exterior secondary drain pan is used that drain should be piped to a location that will give the occupant a visual warning that the primary drain is clogged.

Coils should be installed level or pitched slightly toward the drain end. Suggested pitch should not exceed 1/4 inch per foot of coil.

The coil is provided with a secondary drain that should be trapped and piped to a location that will give the occupant a visual warning that the primary drain is clogged. If the secondary drain is not used it must be capped.

The drain pan connections are designed to ASTM Standard D 2466 Schedule 40. Use 3/4" PVC or steel threaded pipe. Since the drains are not subject to any pressure it is not necessary to use Schedule 40 pipe for drain lines.

SECTION IV: ELECTRIC HEATER INSTALLATION

If the air handler requires electric heat, install the electric heat kit according to the installation instructions included with the kit. After installing the kit, mark the air handler nameplate to designate the heater kit that was installed. If no heater is installed, mark the name plate appropriately to indicate that no heat kit is installed.

Use only 6HK heater kits, as listed on Air Handler name plate and in these instructions. Use data from Tables 5 through 9 for information on required minimum motor speed tap to be used for heating operation, maximum over-current protection device required and minimum electrical supply wiring size required – for listed combination of Air Handler and Heater Kit.

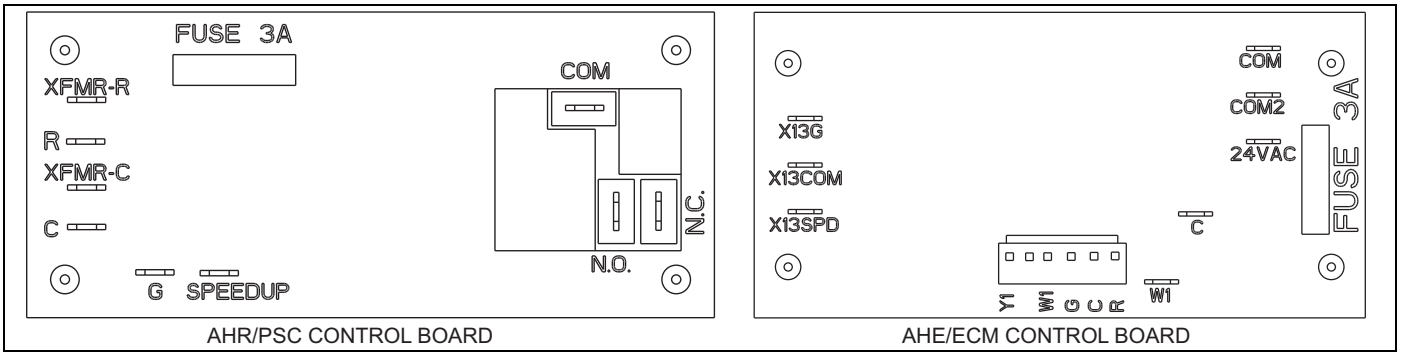


FIGURE 12: Blower Delay Control Board

SECTION V: LINE POWER CONNECTIONS

Power may be brought into the unit through the supply air end of the unit (top when unit is vertical) or the left side panel. Use the hole appropriate to the unit's orientation in each installation to bring conduit from the disconnect. The power lead conduit should be terminated at the electrical control box. Refer to Tables 11, 12, 14 and 15 to determine proper wire sizing. Also see Figure 3. To minimize air leakage, seal the wiring entry point at the outside of the unit.

All electrical connections to air handlers must be made with copper conductors. **Direct connection of aluminum wiring to air handlers is not approved.**

If aluminum conductors are present, all applicable local and national codes must be followed when converting from aluminum to copper conductors prior to connection to the air handler.

If wire other than uncoated (non-plated), 75° C ambient, copper wire is used, consult applicable tables of the National Electric Code (ANSI/NFPA 70). The chosen conductor and connections all must meet or exceed the amperage rating of the overcurrent protector (circuit breaker or fuse) in the circuit.

Additionally, existing aluminum wire within the structure must be sized correctly for the application according to National Electric Code and local codes. Caution must be used when sizing aluminum rather than copper conductors, as aluminum conductors are rated for less current than copper conductors of the same size.

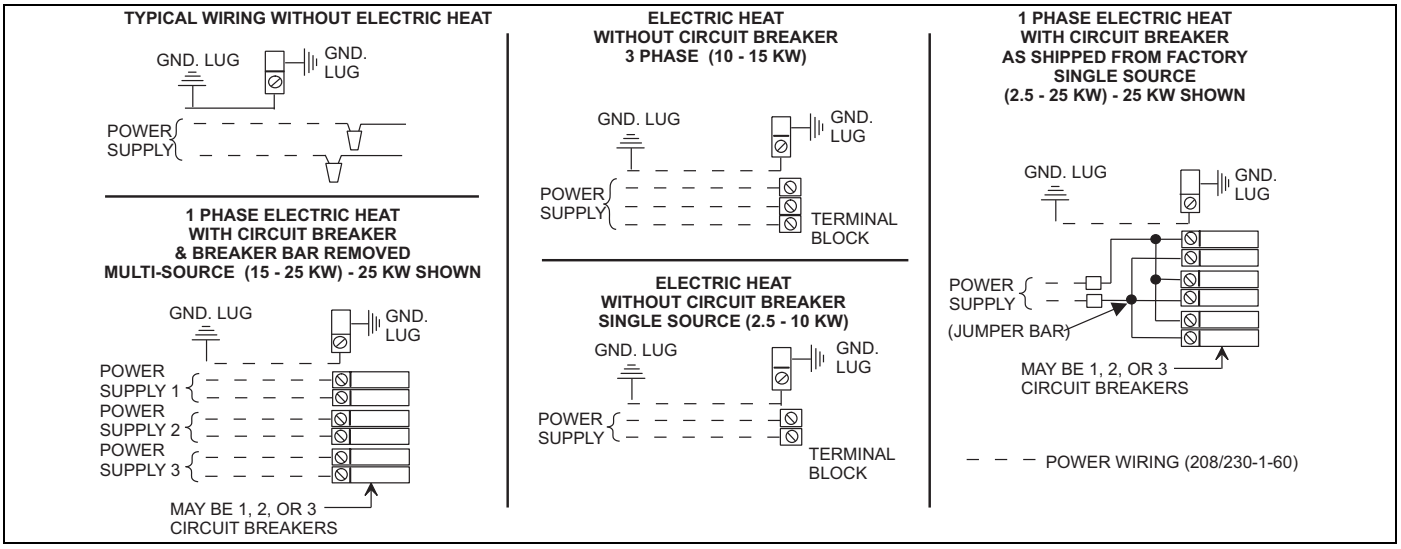

TYPICAL WIRING WITHOUT ELECTRIC HEAT
GND. LUG
GND. LUG
POWER SUPPLY
1 PHASE ELECTRIC HEAT WITH CIRCUIT BREAKER & BREAKER BAR REMOVED MULTI-SOURCE (15 - 25 KW) - 25 KW SHOWN
GND. LUG
GND. LUG
POWER SUPPLY 1
POWER SUPPLY 2
POWER SUPPLY 3
MAY BE 1, 2, OR 3 CIRCUIT BREAKERS
ELECTRIC HEAT WITHOUT CIRCUIT BREAKER 3 PHASE (10 - 15 KW)
GND. LUG
GND. LUG
POWER SUPPLY
TERMINAL BLOCK
ELECTRIC HEAT WITHOUT CIRCUIT BREAKER SINGLE SOURCE (2.5 - 10 KW)
GND. LUG
GND. LUG
POWER SUPPLY
TERMINAL BLOCK
1 PHASE ELECTRIC HEAT WITH CIRCUIT BREAKER AS SHIPPED FROM FACTORY SINGLE SOURCE (2.5 - 25 KW) - 25 KW SHOWN
GND. LUG
GND. LUG
POWER SUPPLY
(JUMPER BAR)
MAY BE 1, 2, OR 3 CIRCUIT BREAKERS
POWER WIRING (208/230-1-60)

FIGURE 13: Line Power Connections

SECTION VI: LOW VOLTAGE CONTROL CONNECTIONS

The 24 volt power supply is provided by an internally wired low voltage transformer which is standard on all models, However, if the unit is connected to a 208 volt power supply, the low voltage transformer must be rewired to the 208 volt tap. See the unit wiring label.

Field supplied low voltage wiring can exit the unit on the top right hand corner or the right hand side panel. Refer to Figure 5.

Remove desired knockout and pierce foil faced insulation to allow wiring to pass through. Use as small of a hole as possible to minimize air leakage. Install a 7/8" plastic bushing in the selected hole and keep low voltage wiring as short as possible inside the control box.

To further minimize air leakage, seal the wiring entry point at the outside of the unit.

The field wiring is to be connected at the pigtails supplied with the control board harness. Refer to SECTIONS X and XI for system wiring.

NOTICE

All wiring must comply with local and national electrical code requirements. Read and heed all unit caution labels.

NOTICE

It is possible to vary the amount of electric heat turned on during the defrost cycle of a heat pump. Standard wiring will only bring on the first stage of electric heat during defrost. See Heat Output and Limit Connections and Table 6 for additional information on heat during defrost cycle.

SECTION VII: BLOWER SPEED CONNECTIONS

Adjust blower motor speed to provide airflow within the minimum and maximum limits approved for evaporator coil, electric heat and outdoor unit. Speed tap adjustments are made at the motor terminal block. Airflow data is shown in Table 15.

Connect motor wires to motor speed tap receptacle for speed desired. See unit wiring label for motor wiring details.

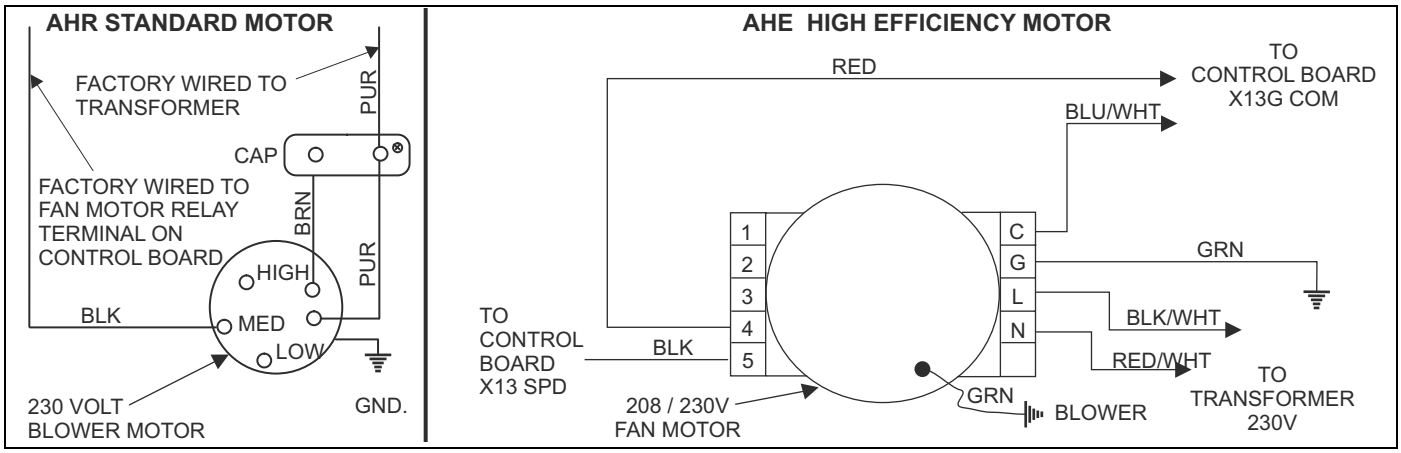


FIGURE 14: Blower Speed Connections

SECTION VIII: UNIT DATA

TABLE 2: Physical and Electrical Data

AHR MODELS								
Models		18B	24B	30B	36B	42C	48D	60D
Blower - Diameter x Width		10 x 8	10 x 8	10 x 8	10 x 8	10 x 10	10X10	10X10
Motor	HP	1/4 HP	1/4 HP	3/4 HP	3/4 HP	3/4 HP	3/4 HP	3/4 HP
	Nominal RPM	1075	1075	1075	1075	1075	1075	1075
Voltage		208/230	208/230	208/230	208/230	208/230	208/230	208/230
Amps	Full Load (230)	1.4	1.4	3.8	3.8	3.8	3.8	3.8
Filter [1]	Type	DISPOSABLE OR PERMANENT						
	Size	16 x 20 x 1	16 x 20 x 1	16 x 20 x 1	16 x 20 x 1	20 x 20 x 1	22 x 20 x 1	22 x 20 x 1
	Permanent Type Kit	1PF0601BK	1PF0601BK	1PF0601BK	1PF0601BK	1PF0602BK	1PF0603BK	1PF0603BK
Shipping / Operating Weight (lbs.)		112/100	117/102	117/105	122/110	148/133	165/147	168/150

1. Field supplied.

AHE MODELS										
Models		18B	22B	24B	30B	34C	36C	42D	48D	60D
Blower - Diameter x Width		10 x 8	10 x 8	10 x 8	10 x 8	11 x 10	11 x 10	11 x 10	11 x 10	11 x 10
Motor	HP	1/3 HP	1/3 HP	1/3 HP	1/3 HP	1/2 HP	1/2 HP	1/2 HP	3/4 HP	3/4 HP
	Nominal RPM	1050	1050	1050	1050	1050	1050	1050	1050	1050
Voltage		208/230	208/230	208/230	208/230	208/230	208/230	208/230	208/230	208/230
Amps	Full Load (230)	2.8	2.8	2.8	2.8	4.1	4.1	4.1	6.0	6.0
Filter [1]	Type	DISPOSABLE OR PERMANENT								
	Size	16 x 20 x 1	16 x 20 x 1	16 x 20 x 1	16 x 20 x 1	20 x 20 x 1	20 x 20 x 1	22 x 20 x 1	22 x 20 x 1	22 x 20 x 1
	Permanent Type Kit	1PF0601BK	1PF0601BK	1PF0601BK	1PF0601BK	1PF0602BK	1PF0602BK	1PF0603BK	1PF0603BK	1PF0603BK
Shipping / Operating Weight (lbs.)		115/103	120/105	120/105	120/105	152/137	152/137	168/150	171/153	174/156

1. Field supplied.

TABLE 3: Conversion Table

kW & MBH Conversions - for Total Power Input Requirement					
FOR	208V	OPERATION MULTIPLY	240V	TABULATED kW & MBH BY	.751
	230V		240V		.918

TABLE 4: Electrical Data - Cooling Only (60 Hz)

Models	Total Motor Amps		Minimum Circuit Ampacity		Max. O.C.P.[1] Amps/Type	Minimum Wire Size A.W.G.
	60 Hertz		60 Hertz			
	208V	230V	208V	230V		
AHR MODELS						
18B	1.3	1.4	1.6	1.8	15	14
24B	1.3	1.4	1.6	1.8	15	14
30B	3.4	3.8	4.3	4.8	15	14
36B	3.4	3.8	4.3	4.8	15	14
42C	3.4	3.8	4.3	4.8	15	14
48D	3.4	3.8	4.3	4.8	15	14
60D	3.4	3.8	4.3	4.8	15	14
AHE MODELS						
18B	2.8	2.8	3.5	3.5	15	14
22B	2.8	2.8	3.5	3.5	15	14
24B	2.8	2.8	3.5	3.5	15	14
30B	2.8	2.8	3.5	3.5	15	14
34C	4.1	4.1	5.1	5.1	15	14
36C	4.1	4.1	5.1	5.1	15	14
42D	4.1	4.1	5.1	5.1	15	14
48D	6.0	6.0	7.5	7.5	15	14
60D	6.0	6.0	7.5	7.5	15	14

1. OCP = Over current protection device, must be HACR type circuit breaker or time delay fuse.

TABLE 5: Electrical Data - 208/230-1-60

Models	Heater Models[1,2]	Max. Static	PSC Min. Speed Tap	ECM Min. Speed Tap	Total Heat[3]				kW Staging			
					kW		MBH		W1 Only		W1 + W2	
					208V	230V	208V	230V	208V	230V	208V	230V
18	6HK(0,1)6500206	0.3	Low	Med Low #2	1.8	2.2	6.1	7.5	1.8	2.2	1.8	2.2
	6HK(0,1)6500506	0.3	Med	Med Low #2	3.6	4.4	12.3	15.0	3.6	4.4	3.6	4.4
	6HK(0,1)6500806	0.3	Med	Med High #4	5.8	7.0	19.7	24.0	5.8	7.0	5.8	7.0
	6HK(1,2)6501006	0.3	Med	Med High #4	7.2	8.8	24.6	29.9	7.2	8.8	7.2	8.8
AHE22	6HK(0,1)6500206	0.3	–	Low #1	1.8	2.2	6.1	7.5	1.8	2.2	1.8	2.2
	6HK(0,1)6500506	0.3	–	Med Low #2	3.6	4.4	12.3	15.0	3.6	4.4	3.6	4.4
	6HK(0,1)6500806	0.3	–	Med #3	5.8	7.0	19.7	24.0	5.8	7.0	5.8	7.0
	6HK(0,1)6501006	0.3	–	Med High #4	7.2	8.8	24.6	29.9	7.2	8.8	7.2	8.8
	6HK(0,1)6501306	0.3	–	Med High #4	9.4	11.4	31.9	38.9	3.1	3.8	9.4	11.4
	6HK(1,2)6501506	0.3	–	High #5	10.8	13.2	36.9	44.9	3.6	4.4	10.8	13.2
24	6HK(0,1)6500206	0.3	Low	Low #1	1.8	2.2	6.1	7.5	1.8	2.2	1.8	2.2
	6HK(0,1)6500506	0.3	Low	Med Low #2	3.6	4.4	12.3	15.0	3.6	4.4	3.6	4.4
	6HK(0,1)6500806	0.3	Med	Med #3	5.8	7.0	19.7	24.0	5.8	7.0	5.8	7.0
	6HK(0,1)6501006	0.3	Med	Med High #4	7.2	8.8	24.6	29.9	7.2	8.8	7.2	8.8
	6HK(1,2)6501306	0.3	High	Med High #4	9.4	11.4	31.9	38.9	3.1	3.8	9.4	11.4
	6HK(1,2)6501506	0.3	High	High #5	10.8	13.2	36.9	44.9	3.6	4.4	10.8	13.2
30	6HK(0,1)6500206	0.3	Low	Low #1	1.8	2.2	6.1	7.5	1.8	2.2	1.8	2.2
	6HK(0,1)6500506	0.3	Low	Med Low #2	3.6	4.4	12.3	15.0	3.6	4.4	3.6	4.4
	6HK(0,1)6500806	0.3	Med	Med #3	5.8	7.0	19.7	24.0	5.8	7.0	5.8	7.0
	6HK(0,1)6501006	0.3	Med	Med High #4	7.2	8.8	24.6	29.9	7.2	8.8	7.2	8.8
	6HK(1,2)6501306	0.3	High	Med High #4	9.4	11.4	31.9	38.9	3.1	3.8	9.4	11.4
	6HK(1,2)6501506	0.3	High	High #5	10.8	13.2	36.9	44.9	3.6	4.4	10.8	13.2

For notes see Page 10.

TABLE 5: Electrical Data - 208/230-1-60 **(Continued)**

Models	Heater Models[1,2]	Max. Static	PSC Min. Speed Tap	ECM Min. Speed Tap	Total Heat[3]				kW Staging			
					kW		MBH		W1 Only		W1 + W2	
					208V	230V	208V	230V	208V	230V	208V	230V
AHE34	6HK(0,1)6500206	0.3	–	Low #1	1.8	2.2	6.1	7.5	1.8	2.2	1.8	2.2
	6HK(0,1)6500506	0.3	–	Med Low #2	3.6	4.4	12.3	15.0	3.6	4.4	3.6	4.4
	6HK(0,1)6500806	0.3	–	Med #3	5.8	7.0	19.7	24.0	5.8	7.0	5.8	7.0
	6HK(0,1)6501006	0.3	–	Med High #4	7.2	8.8	24.6	29.9	7.2	8.8	7.2	8.8
	6HK(0,1)6501306	0.3	–	Med High #4	9.4	11.4	31.9	38.9	3.1	3.8	9.4	11.4
	6HK(1,2)6501506	0.3	–	Med High #4	10.8	13.2	36.9	44.9	3.6	4.4	10.8	13.2
	6HK(1,2)6501806	0.3	–	High #5	13.0	15.8	44.2	53.9	6.5	7.9	13.0	15.8
	6HK(1,2)6502006	0.3	–	High #5	14.4	17.5	49.1	59.9	7.2	8.8	14.4	17.6
36	6HK(0,1)6500206	0.3	Low	Low #1	1.8	2.2	6.1	7.5	1.8	2.2	1.8	2.2
	6HK(0,1)6500506	0.3	Low	Med Low #2	3.6	4.4	12.3	15.0	3.6	4.4	3.6	4.4
	6HK(0,1)6500806	0.3	Med	Med #3	5.8	7.0	19.7	24.0	5.8	7.0	5.8	7.0
	6HK(0,1)6501006	0.3	Med	Med High #4	7.2	8.8	24.6	29.9	7.2	8.8	7.2	8.8
	6HK(1,2)6501306	0.3	High	Med High #4	9.4	11.4	31.9	38.9	3.1	3.8	9.4	11.4
	6HK(1,2)6501506	0.3	High	Med High #4	10.8	13.2	36.9	44.9	3.6	4.4	10.8	13.2
	6HK(1,2)6501806	0.3	High	High #5	13.0	15.8	44.2	53.9	6.5	7.9	13.0	15.8
	6HK(1,2)6502006	0.3	High	High #5	14.4	17.5	49.1	59.9	7.2	8.8	14.4	17.6
42	6HK(0,1)6500206	0.3	Low	Low #1	1.8	2.2	6.1	7.5	1.8	2.2	1.8	2.2
	6HK(0,1)6500506	0.3	Low	Med #3	3.6	4.4	12.3	15.0	3.6	4.4	3.6	4.4
	6HK(0,1)6500806	0.3	Med	Med #3	5.8	7.0	19.7	24.0	5.8	7.0	5.8	7.0
	6HK(0,1)6501006	0.3	Med	Med High #4	7.2	8.8	24.6	29.9	7.2	8.8	7.2	8.8
	6HK(1,2)6501306	0.3	High	High #5	9.4	11.4	31.9	38.9	3.1	3.8	9.4	11.4
	6HK(1,2)6501506	0.3	High	High #5	10.8	13.2	36.9	44.9	3.6	4.4	10.8	13.2
48	6HK(0,1)6500206	0.3	Low	Low #1	1.8	2.2	6.1	7.5	1.8	2.2	1.8	2.2
	6HK(0,1)6500506	0.3	Low	Low #1	3.6	4.4	12.3	15.0	3.6	4.4	3.6	4.4
	6HK(0,1)6500806	0.3	Low	Med Low #2	5.8	7.0	19.7	24.0	5.8	7.0	5.8	7.0
	6HK(0,1)6501006	0.3	Med	Med Low #2	7.2	8.8	24.6	29.9	7.2	8.8	7.2	8.8
	6HK(1,2)6501306	0.3	Med	Med #3	9.4	11.4	31.9	38.9	3.1	3.8	9.4	11.4
	6HK(1,2)6501506	0.3	Med	Med #3	10.8	13.2	36.9	44.9	3.6	4.4	10.8	13.2
	6HK(1,2)6501806	0.3	Med	Med High #4	13.0	15.8	44.2	53.9	6.5	7.9	13.0	15.8
	6HK(1,2)6502006	0.3	High	High #5	14.4	17.5	49.1	59.9	7.2	8.8	14.4	17.6
60	6HK(0,1)6500206	0.3	Low	Low #1	1.8	2.2	6.1	7.5	1.8	2.2	1.8	2.2
	6HK(0,1)6500506	0.3	Low	Low #1	3.6	4.4	12.3	15.0	3.6	4.4	3.6	4.4
	6HK(0,1)6500806	0.3	Low	Low #1	5.8	7.0	19.7	24.0	5.8	7.0	5.8	7.1
	6HK(0,1)6501006	0.3	Med	Med Low #2	7.2	8.8	24.6	29.9	7.2	8.8	7.2	8.8
	6HK(1,2)6501306	0.3	Med	Med #3	9.4	11.4	31.9	38.9	3.1	3.8	9.4	11.4
	6HK(1,2)6501506	0.3	Med	Med #3	10.8	13.2	36.9	44.9	3.6	4.4	10.8	13.2
	6HK(1,2)6501806	0.3	Med	Med High #4	13.0	15.8	44.2	53.9	6.5	7.9	13.0	15.8
	6HK(1,2)6502006	0.3	High	Med High #4	14.4	17.5	49.1	59.9	7.2	8.8	14.4	17.6
	6HK(1,2)6502506	0.3	High	High #5	18.0	21.9	61.4	74.9	7.2	8.8	18.0	22.0

1. (0,1) - maybe 0 (no circuit breaker) or 1 (with circuit breaker).
2. (1,2) maybe 1 (with circuit breaker, no breaker jumper bar) or 2 (with circuit breaker & breaker jumper bar).
3. See conversion Table 3.

TABLE 6: Electrical Data - (For **Single Source** Power Supply) - Copper Wire - 208/230-1-60 (AHR)

Models	Heater Models[1,2]	Heater Amps 240V	Field Wiring					
			Min. Circuit Ampacity		Max. O.C.P.[3] Amps/Type		75°C Wire Size - AWG	
			208V	230V	208V	230V	208V	230V
AHR18B3XH21	6HK(0,1)6500206	10.0	12.42	13.73	15	15	12	12
	6HK(0,1)6500506	20.0	23.25	25.71	25	30	10	10
	6HK(0,1)6500806	32.0	36.25	40.08	40	45	8	8
	6HK(0,1)6501006	40.0	44.92	49.67	45	50	8	6
AHR24B3XH21	6HK(0,1)6500206	10.0	12.42	13.73	15	15	12	12
	6HK(0,1)6500506	20.0	23.25	25.71	30	30	10	10
	6HK(0,1)6500806	32.0	36.25	40.08	40	50	8	8
	6HK(0,1)6501006	40.0	44.92	49.67	45	50	8	6
	6HK(1,2)6501306	52.0	57.92	64.04	60	70	4	4
	6HK(1,2)6501506	60.0	66.58	73.63	70	80	4	4
AHR30B3XH21	6HK(0,1)6500206	10.0	15.13	16.73	20	20	12	12
	6HK(0,1)6500506	20.0	25.96	28.71	30	30	10	10
	6HK(0,1)6500806	32.0	38.96	43.08	40	45	8	8
	6HK(0,1)6501006	40.0	47.63	52.67	50	60	6	6
	6HK(1,2)6501306	52.0	60.63	67.04	70	70	6	4
	6HK(1,2)6501506	60.0	69.30	76.63	70	80	4	4
AHR36B3XH21	6HK(0,1)6500206	10.0	15.13	16.73	20	20	12	12
	6HK(0,1)6500506	20.0	25.96	28.71	30	30	10	10
	6HK(0,1)6500806	32.0	38.96	43.08	40	45	8	8
	6HK(0,1)6501006	40.0	47.63	52.67	50	60	8	6
	6HK(1,2)6501306	52.0	60.63	67.04	70	70	6	4
	6HK(1,2)6501506	60.0	69.30	76.63	70	80	4	4
	6HK(1,2)6501806	72.0	82.30	91.00	90	100	3	3
	6HK(1,2)6502006	80.0	91.0	100.6	100	110	3	2
AHR42C3XH21	6HK(0,1)6500206	10.0	15.1	16.7	20	20	12	12
	6HK(0,1)6500506	20.0	26.0	28.7	30	30	10	10
	6HK(0,1)6500806	32.0	39.0	43.1	40	45	8	8
	6HK(0,1)6501006	40.0	47.6	52.7	50	60	6	6
	6HK(1,2)6501306	52.0	60.6	67.0	70	70	6	4
	6HK(1,2)6501506	60.0	69.30	76.63	70	80	4	4
AHR48D3XH21	6HK(0,1)6500206	10.0	15.1	16.7	20	20	12	12
	6HK(0,1)6500506	20.0	26.0	28.7	30	30	10	10
	6HK(0,1)6500806	32.0	39.0	43.1	40	45	8	8
	6HK(0,1)6501006	40.0	47.6	52.7	50	60	6	6
	6HK(1,2)6501306	52.0	60.6	67.0	70	70	6	4
	6HK(1,2)6501506	60.0	69.3	76.6	70	80	4	4
	6HK(1,2)6501806	72.0	82.3	91.0	90	100	3	3
	6HK(1,2)6502006	80.0	91.0	100.6	100	110	3	2
AHR60D3XH21	6HK(0,1)6500206	10.0	15.1	16.7	20	20	12	12
	6HK(0,1)6500506	20.0	26.0	28.7	30	30	10	10
	6HK(0,1)6500806	32.0	39.0	43.1	40	45	8	8
	6HK(0,1)6501006	40.0	47.6	52.7	50	60	6	6
	6HK(1,2)6501306	52.0	60.6	67.0	70	70	6	4
	6HK(1,2)6501506	60.0	69.3	76.6	70	80	4	4
	6HK(1,2)6501806	72.0	82.3	91.0	90	100	3	3
	6HK(1,2)6502006	80.0	91.0	100.6	100	110	3	2
	6HK(1,2)6502506	100.0	112.6	124.5	115	130	1	1

1. (0,1) - maybe 0 (no circuit breaker) or 1 (with circuit breaker).
2. (1,2) maybe 1 (with circuit breaker, no breaker jumper bar) or 2 (with circuit breaker & breaker jumper bar).
3. O.C.P. = Over current protection device, must be HACR type circuit breaker or time delay fuse.

TABLE 7: Electrical Data - (For **Single Source** Power Supply) - Copper Wire - 208/230-1-60 (AHE)

Models	Heater Models[1,2]	Heater Amps 240V	Field Wiring					
			Min. Circuit Ampacity		Max. O.C.P.[3] Amps/Type		75°C Wire Size - AWG	
			208V	230V	208V	230V	208V	230V
AHE18B3XH21	6HK(0,1)6500206	10.0	14.33	15.48	15	20	12	12
	6HK(0,1)6500506	20.0	25.17	27.46	30	30	10	10
	6HK(0,1)6500806	32.0	38.17	41.83	40	45	8	8
	6HK(0,1)6501006	40.0	46.83	51.42	50	60	8	6
AHE22B3XH21	6HK(0,1)6500206	10.0	14.33	15.48	15	20	12	12
	6HK(0,1)6500506	20.0	25.17	27.46	30	30	10	10
	6HK(0,1)6500806	32.0	38.17	41.83	40	45	8	8
	6HK(0,1)6501006	40.0	46.83	51.42	50	60	8	6
	6HK(1,2)6501306	52.0	59.83	65.79	60	70	6	4
	6HK(1,2)6501506	60.0	68.50	75.38	70	80	4	4
AHE24B3XH21	6HK(0,1)6500206	10.0	14.33	15.48	15	20	12	12
	6HK(0,1)6500506	20.0	25.17	27.46	30	30	10	10
	6HK(0,1)6500806	32.0	38.17	41.83	40	45	8	8
	6HK(0,1)6501006	40.0	46.83	51.42	50	60	8	6
	6HK(1,2)6501306	52.0	59.83	65.79	60	70	6	4
	6HK(1,2)6501506	60.0	68.50	75.38	70	80	4	4
AHE30B3XH21	6HK(0,1)6500206	10.0	14.33	15.48	15	20	12	12
	6HK(0,1)6500506	20.0	25.17	27.46	30	30	10	10
	6HK(0,1)6500806	32.0	38.17	41.83	40	50	8	8
	6HK(0,1)6501006	40.0	46.83	51.42	50	60	6	6
	6HK(1,2)6501306	52.0	59.83	65.79	60	70	6	4
	6HK(1,2)6501506	60.0	68.50	75.38	70	80	4	4
AHE34C3XH21	6HK(0,1)6500206	10.0	15.96	17.10	20	20	12	12
	6HK(0,1)6500506	20.0	26.79	29.08	30	30	10	10
	6HK(0,1)6500806	32.0	39.79	43.46	40	45	8	8
	6HK(0,1)6501006	40.0	48.46	53.04	50	60	8	6
	6HK(1,2)6501306	52.0	61.46	67.42	70	70	6	4
	6HK(1,2)6501506	60.0	70.13	77.00	80	80	4	4
	6HK(1,2)6501806	72.0	83.13	91.38	90	100	3	3
	6HK(1,2)6502006	80.0	91.79	100.96	100	110	3	2
AHE36C3XH21	6HK(0,1)6500206	10.0	15.96	17.10	20	20	12	12
	6HK(0,1)6500506	20.0	26.79	29.08	30	30	10	10
	6HK(0,1)6500806	32.0	39.79	43.46	40	45	8	8
	6HK(0,1)6501006	40.0	48.46	53.04	50	60	8	6
	6HK(1,2)6501306	52.0	61.46	67.42	70	70	6	4
	6HK(1,2)6501506	60.0	70.13	77.00	80	80	4	4
	6HK(1,2)6501806	72.0	83.13	91.38	90	100	3	3
	6HK(1,2)6502006	80.0	91.79	100.96	100	110	3	2
AHE42D3XH21	6HK(0,1)6500206	10.0	15.96	17.10	20	20	12	12
	6HK(0,1)6500506	20.0	26.79	29.08	30	30	10	10
	6HK(0,1)6500806	32.0	39.79	43.46	40	45	8	8
	6HK(0,1)6501006	40.0	48.46	53.04	50	60	6	6
	6HK(1,2)6501306	52.0	61.46	67.42	70	70	6	4
	6HK(1,2)6501506	60.0	70.13	77.00	80	80	4	4

For notes see Page 13.

TABLE 7: Electrical Data - (For **Single Source** Power Supply) - Copper Wire - 208/230-1-60 (AHE) (Continued)

Models	Heater Models[1,2]	Heater Amps 240V	Field Wiring					
			Min. Circuit Ampacity		Max. O.C.P.[3] Amps/Type		75°C Wire Size - AWG	
			208V	230V	208V	230V	208V	230V
AHE48D3XH21	6HK(0,1)6500206	10.0	18.3	19.5	20	20	12	12
	6HK(0,1)6500506	20.0	29.2	31.5	30	35	10	10
	6HK(0,1)6500806	32.0	42.2	45.8	45	50	8	8
	6HK(0,1)6501006	40.0	50.8	55.4	60	60	6	6
	6HK(1,2)6501306	52.0	63.8	69.8	70	70	4	4
	6HK(1,2)6501506	60.0	72.5	79.4	80	80	4	4
	6HK(1,2)6501806	72.0	85.5	93.8	90	100	3	3
	6HK(1,2)6502006	80.0	94.2	103.3	100	110	3	2
AHE60D3XH21	6HK(0,1)6500206	10.0	18.3	19.5	20	20	12	12
	6HK(0,1)6500506	20.0	29.2	31.5	30	35	10	10
	6HK(0,1)6500806	32.0	42.2	45.8	45	50	8	8
	6HK(0,1)6501006	40.0	50.8	55.4	60	60	6	6
	6HK(1,2)6501306	52.0	63.8	69.8	70	70	4	4
	6HK(1,2)6501506	60.0	72.5	79.4	80	80	4	4
	6HK(1,2)6501806	72.0	85.5	93.8	90	100	3	3
	6HK(1,2)6502006	80.0	94.2	103.3	100	110	3	2
	6HK(1,2)6502506	100.0	115.8	127.3	120	130	1	1

1. (0,1) - maybe 0 (no circuit breaker) or 1 (with circuit breaker).
2. (1,2) maybe 1 (with circuit breaker, no breaker jumper bar) or 2 (with circuit breaker & breaker jumper bar).
3. O.C.P. = Over current protection device, must be HACR type circuit breaker or time delay fuse.

TABLE 8: Electrical Data - (For **Multi-Source** Power Supply) - Copper Wire - 208/230-1-60[1] (AHR)

Models	Heater Models[2,3]	Min. Circuit Ampacity		Max. O.C.P.[4] Amps/Type		75°C Wire Size - AWG	
		Circuit		Circuit		Circuit	
		1st	2nd	1st	2nd	1st	2nd
		208/230	208/230	208/230	208/230	208/230	208/230
AHR24B3XH21	6HK(1,2)6501306	37.5/41.3	20.3/22.4	40/45	25/25	8/8	12/12
	6HK(1,2)6501506	43.3/47.8	23.2/25.5	45/50	25/30	8/8	12/10
AHR30B3XH21	6HK(1,2)6501306	37.5/41.3	23.0/25.4	40/45	25/30	8/8	10/10
	6HK(1,2)6501506	43.3/47.8	25.9/28.7	45/50	30/30	8/8	10/10
AHR36B3XH21	6HK(1,2)6501306	37.5/41.3	23.0/25.4	40/45	25/30	8/8	12/12
	6HK(1,2)6501506	43.3/47.8	25.9/28.7	45/50	30/35	8/8	10/10
	6HK(1,2)6501806	38.9/42.9	43.2/47.7	40/45	50/50	8/8	8/8
	6HK(1,2)6502006	43.3/47.8	47.6/52.6	45/50	50/60	8/8	8/6
AHR42C3XH21	6HK(1,2)6501306	37.5/41.3	23.0/25.4	40/45	25/30	8/8	12/12
	6HK(1,2)6501506	43.3/47.8	25.9/28.7	45/50	30/30	8/8	10/10
AHR48D3XH21	6HK(1,2)6501306	37.5/41.3	23.0/25.4	40/45	25/30	8/8	12/12
	6HK(1,2)6501506	43.3/47.8	25.9/28.7	45/50	30/30	8/8	10/10
	6HK(1,2)6501806	38.9/42.9	43.2/47.7	40/45	45/50	8/8	8/8
	6HK(1,2)6502006	43.3/47.8	47.6/52.6	45/50	50/60	8/8	8/6
AHR60D3XH21	6HK(1,2)6501306	37.5/41.3	23.0/25.4	40/45	25/30	8/8	12/12
	6HK(1,2)6501506	43.3/47.8	25.9/28.7	45/50	30/30	8/8	10/10
	6HK(1,2)6501806	38.9/42.9	43.2/47.7	40/45	45/50	8/8	8/8
	6HK(1,2)6502006	43.3/47.8	47.6/52.6	45/50	50/60	8/8	8/6
	6HK(1,2)6502506	64.9/71.7	47.6/52.6	70/80	50/60	4/4	8/6

1. If wire other than non-plated, 75° ambient, copper wire is used. consult applicable tables of the NEC and local codes.
2. (0,1) - maybe 0 (no circuit breaker) or 1 (with circuit breaker).
3. (1,2) maybe 1 (with circuit breaker, no breaker jumper bar) or 2 (with circuit breaker & breaker jumper bar).
4. O.C.P. = Over current protection device, must be HACR type circuit breaker or time delay fuse.

TABLE 9: Electrical Data - (For **Multi-Source** Power Supply) - Copper Wire - 208/230-1-60[1] (AHE)

Models	Heater Models[2,3]	Min. Circuit Ampacity		Max. O.C.P.[4] Amps/Type		75°C Wire Size - AWG	
		Circuit		Circuit		Circuit	
		1st	2nd	1st	2nd	1st	2nd
		208/230	208/230	208/230	208/230	208/230	208/230
AHE22B3XH21	6HK(1,2)6501306	37.5/41.3	22.3/24.2	40/45	25/25	8/8	12/12
	6HK(1,2)6501506	43.3/47.8	25.1/27.4	45/50	30/30	8/8	10/10
AHE24B3XH21	6HK(1,2)6501306	37.5/41.3	22.3/24.2	40/45	25/25	8/8	12/12
	6HK(1,2)6501506	43.3/47.8	25.1/27.4	45/50	30/30	8/8	10/10
AHE30B3XH21	6HK(1,2)6501306	37.5/41.3	22.3/24.2	40/45	25/25	8/8	12/12
	6HK(1,2)6501506	43.3/47.8	26.8/27.4	45/50	30/30	8/8	10/10
AHE34C3XH21	6HK(1,2)6501306	37.5/41.3	23.9/25.8	40/45	25/30	8/8	12/10
	6HK(1,2)6501506	43.3/47.8	27.7/29.0	45/50	30/30	8/8	10/10
	6HK(1,2)6501806	38.9/42.9	44.1/48.0	40/45	45/50	8/8	8/8
	6HK(1,2)6502006	43.3/47.8	48.4/53.0	45/50	50/60	8/8	6/6
AHE36C3XH21	6HK(1,2)6501306	37.5/41.3	23.9/25.8	40/45	25/30	8/8	12/10
	6HK(1,2)6501506	43.3/47.8	27.7/29.0	45/50	30/30	8/8	10/10
	6HK(1,2)6501806	38.9/42.9	44.1/48.0	40/45	45/50	8/8	8/8
	6HK(1,2)6502006	43.3/47.8	48.4/53.0	45/50	50/60	8/8	6/6
AHE42D3XH21	6HK(1,2)6501306	37.5/41.3	23.9/25.8	45/45	25/30	8/8	12/10
	6HK(1,2)6501506	43.3/47.8	27.7/29.0	45/50	30/30	8/8	10/10
AHE48D3XH21	6HK(1,2)6501306	37.5/41.3	26.3/28.2	40/45	30/30	8/8	10/10
	6HK(1,2)6501506	43.3/47.8	29.1/31.4	45/50	30/35	8/8	10/10
	6HK(1,2)6501806	38.9/42.9	46.4/50.4	40/45	50/60	8/8	8/8
	6HK(1,2)6502006	43.3/47.8	50.8/55.3	45/50	60/60	8/8	6/6
AHE60D3XH21	6HK(1,2)6501306	37.5/41.3	26.3/28.2	40/45	30/30	8/8	10/10
	6HK(1,2)6501506	43.3/47.8	29.1/31.4	45/50	30/35	8/8	10/10
	6HK(1,2)6501806	38.9/42.9	46.4/50.4	40/45	50/60	8/8	8/8
	6HK(1,2)6502006	43.3/47.8	50.8/55.3	45/50	60/60	8/8	6/6
	6HK(1,2)6502506	64.9/71.7	50.8/55.3	70/80	60/60	4/4	6/6

1. If wire other than non-plated, 75° ambient, copper wire is used. consult applicable tables of the NEC and local codes.
2. (0,1) - maybe 0 (no circuit breaker) or 1 (with circuit breaker).
3. (1,2) maybe 1 (with circuit breaker, no breaker jumper bar) or 2 (with circuit breaker & breaker jumper bar).
4. O.C.P. = Over current protection device, must be HACR type circuit breaker or time delay fuse.

TABLE 10: Electrical Data - 208/230-3-60

Models	Heater Models[1]	Max. Static	PSC Min. Speed Tap	ECM Min. Speed Tap	Total Heat[2]				kW Staging			
					kW		MBH		W1 Only		W1 + W2	
					208V	230V	208V	230V	208V	230V	208V	230V
AHE22	6HK06501525	0.3	High	High #5	10.8	14.4	36.9	49.1	10.8	14.4	10.8	14.4
AHR/AHE24	6HK06501525	0.3	High	High #5	10.8	14.4	36.9	49.1	10.8	14.4	10.8	14.4
AHR/AHE30	6HK06501525	0.3	High	High #5	10.8	14.4	36.9	49.1	10.8	14.4	10.8	14.4
AHE34	6HK06501525	0.3	Med	Med High #4	10.8	14.4	36.9	49.1	10.8	14.4	10.8	14.4
	6HK16502025	0.3	High	High #5	14.4	19.2	49.1	65.5	7.2	9.6	14.4	19.2
AHR/AHE36	6HK06501525	0.3	Med	Med High #4	10.8	14.4	36.9	49.1	10.8	14.4	10.8	14.4
	6HK16502025	0.3	High	High #5	14.4	19.2	49.1	65.5	7.2	9.6	14.4	19.2
AHR42C	6HK06501525	0.3	Med	Med High #4	10.8	14.4	36.9	49.1	10.8	14.4	10.8	14.4
AHE42D	6HK06501525	0.3	High	High #5	10.8	14.4	36.9	49.1	10.8	14.4	10.8	14.4
	6HK16502025	0.3	High	High #5	14.4	19.2	49.1	65.5	7.2	9.6	14.4	19.2
AHR/AHE48	6HK06501525	0.3	High	High #5	10.8	14.4	36.9	49.1	10.8	14.4	10.8	14.4
	6HK16502025	0.3	High	High #5	14.4	19.2	49.1	65.5	7.2	9.6	14.4	19.2
AHR/AHE60	6HK06501525	0.3	High	High #5	10.8	14.4	36.9	49.1	10.8	14.4	10.8	14.4
	6HK16502025	0.3	High	High #5	14.4	19.2	49.1	65.5	7.2	9.6	14.4	19.2
	6HK16502525	0.3	High	High #5	18	24	61.4	81.9	9.0	12.0	18.0	24.0

1. May be 0 (no circuit breaker) or 1 (with circuit breaker).
2. See conversion Table 3.

TABLE 11: Electrical Data - (For **Single Source** Power Supply) - Copper Wire - 208/230-3-60 (AHR)

Models	Heater Models[1]	Heater Amps 240V	Field Wiring					
			Min. Circuit Ampacity		Max. O.C.P.[2] Amps/Type		75°C Wire Size - AWG	
			208V	230V	208V	230V	208V	230V
AHR24B	6HK06501525	34.6	39.1	43.20	40	45	8	8
AHR30B	6HK06501525	34.6	41.7	46.20	45	50	8	8
AHR36B	6HK06501525	34.6	41.7	46.20	45	50	8	8
	6HK16502025	46.2	54.3	60.09	60	70	6	4
AHR42C	6HK06501525	34.6	41.7	46.20	45	50	8	8
AHR48D	6HK06501525	34.6	41.7	46.20	45	50	8	8
	6HK16502025	46.2	54.3	60.09	60	70	6	4
AHR60D	6HK06501525	34.6	41.7	46.20	45	50	8	8
	6HK16502025	46.2	54.3	60.09	60	70	6	4
	6HK16502525	57.7	66.8	73.87	70	80	4	4

1. May be 0 (no circuit breaker) or 1 (with circuit breaker).
2. O.C.P. = Over current protection device, must be HACR type circuit breaker or time delay fuse.

TABLE 12: Electrical Data - (For **Single Source** Power Supply) - Copper Wire - 208/230-3-60 (AHE)

Models	Heater Models[1]	Heater Amps 240V	Field Wiring					
			Min. Circuit Ampacity		Max. O.C.P.[2] Amps/Type		75°C Wire Size - AWG	
			208V	230V	208V	230V	208V	230V
AHE22B	6HK06501525	34.6	41.0	44.95	45	50	8	8
AHE24B	6HK06501525	34.6	41.0	44.95	45	50	8	8
AHE30B	6HK06501525	34.6	41.0	44.95	45	50	8	8
AHE34C	6HK06501525	34.6	42.6	46.57	45	50	8	8
	6HK16502025	46.2	55.2	60.47	60	70	6	4
AHE36C	6HK06501525	34.6	42.6	46.57	45	50	8	8
	6HK16502025	46.2	55.2	60.47	60	70	6	4
AHE42D	6HK06501525	34.6	42.6	46.57	45	50	8	8
	6HK16502025	46.2	55.2	60.47	60	70	6	4
AHE48D	6HK06501525	34.6	45.0	48.95	50	50	8	8
	6HK16502025	46.2	57.6	62.84	60	70	6	4
AHE60D	6HK06501525	34.6	45.0	48.95	50	50	8	8
	6HK16502025	46.2	57.6	62.84	60	70	6	4
	6HK16502525	57.7	70.0	76.62	80	80	4	4

1. May be 0 (no circuit breaker) or 1 (with circuit breaker).
2. O.C.P. = Over current protection device, must be HACR type circuit breaker or time delay fuse.

TABLE 13: Electrical Data - (For **Multi-Source** Power Supply) - Copper Wire - 208/230-3-60[1] (AHR)

Models	Heater Models	Min. Circuit Ampacity		Max. O.C.P.[2] Amps/Type		75°C Wire Size - AWG	
		Circuit		Circuit		Circuit	
		1st	2nd	1st	2nd	1st	2nd
		208/230	208/230	208/230	208/230	208/230	208/230
AHR36B	6HK16502025	29.3/33.6	25/28.9	30/35	30/30	10/10	10/10
AHR48D	6HK16502025	29.3/33.6	25/28.9	30/35	30/30	10/10	10/10
AHR60D	6HK16502025	29.3/33.6	25/28.9	30/35	30/30	10/10	10/10
	6HK16502525	35.5/40.3	31.3/36.1	40/45	35/40	8/8	10/8

1. If wire other than non-plated, 75° ambient, copper wire is used. consult applicable tables of the NEC and local codes.
2. O.C.P. = Over current protection device, must be HACR type circuit breaker or time delay fuse.

TABLE 14: Electrical Data - (For **Multi-Source** Power Supply) - Copper Wire - 208/230-3-60[1] (AHE)

Models	Heater Models	Min. Circuit Ampacity		Max. O.C.P.[2] Amps/Type		75°C Wire Size - AWG	
		Circuit		Circuit		Circuit	
		1st	2nd	1st	2nd	1st	2nd
		208/230	208/230	208/230	208/230	208/230	208/230
AHE34C	6HK16502025	30.1/34.0	25/28.9	35/35	30/30	10/10	10/10
AHE36C	6HK16502025	30.1/34.0	25/28.9	35/35	30/30	10/10	10/10
AHE42D	6HK16502025	30.1/34.0	25/28.9	35/35	30/30	10/10	10/10
AHE48D	6HK16502025	32.5/36.4	25/28.9	35/40	30/30	10/8	10/10
AHE60D	6HK16502025	32.5/36.4	25/28.9	35/40	30/30	10/8	10/10
	6HK16502525	38.8/43.6	31.3/36.1	40/45	35/40	8/8	10/8

1. If wire other than non-plated, 75° ambient, copper wire is used. consult applicable tables of the NEC and local codes.
2. O.C.P. = Over current protection device, must be HACR type circuit breaker or time delay fuse.

TABLE 15: Air Flow Data - 60 Hz Models - 208/230 Volt (AHR)

Models	Blower Motor Speed	CFM[1] @ External Static Pressure - IWC							m3/min @ External static pressure - Pascal						
		0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.003	0.005	0.008	0.010	0.013	0.015	0.018
208 Volt															
AHR18B	High	1024	1000	970	930	860	810	NA	28.7	28.0	27.2	26.0	24.1	22.7	NA
	Medium	756	731	700	670	620	550	NA	21.2	20.5	19.6	18.8	17.3	15.4	NA
	Low	557	531	495	445	375	315	195	15.6	14.9	13.9	12.5	10.5	8.8	5.5
AHR24B	High	995	970	935	900	925	795	645	27.9	27.2	26.2	25.2	25.9	22.3	18.1
	Medium	820	810	780	745	695	545	485	23.0	22.7	21.8	20.9	19.5	15.3	13.6
	Low	715	695	640	405	370	375	220	20.0	19.5	17.9	11.3	10.4	10.5	6.2
AHR30B	High	1380	1315	1245	1160	1075	990	885	38.6	36.8	34.9	32.5	30.1	27.7	24.8
	Medium	1060	1040	1005	955	890	860	820	29.7	29.1	28.1	26.7	24.9	24.1	23.0
	Low	1035	980	910	825	770	685	485	29.0	27.4	25.5	23.1	21.6	19.2	13.6
AHR36B	High	1410	1335	1270	1190	1110	990	820	39.5	37.4	35.6	33.3	31.1	27.7	23.0
	Medium	1215	1170	1115	1050	935	850	740	34.0	32.8	31.2	29.4	26.2	23.8	20.7
	Low	950	935	895	855	NA	NA	NA	26.6	26.2	25.1	23.9	NA	NA	NA
AHR42C	High	1800	1725	1645	1545	1360	1200	1050	50.4	48.3	46.1	43.3	38.1	33.6	29.4
	Medium	1535	1480	1415	1280	1155	1010	870	43.0	41.4	39.6	35.8	32.3	28.3	24.4
	Low	1225	1195	1095	1025	925	825	680	34.3	33.5	30.7	28.7	25.9	23.1	19.0
AHR48D	High	1890	1830	1755	1650	1565	1450	1285	52.9	51.2	49.1	46.2	43.8	40.6	36.0
	Medium	1515	1480	1450	1380	1295	1115	985	42.4	41.4	40.6	38.6	36.3	31.2	27.6
	Low	1170	1165	1140	1100	965	860	745	32.8	32.6	31.9	30.8	27.0	24.1	20.9
AHR60D	High	1911	1841	1757	1668	1564	1439	1233	53.5	51.5	49.2	46.7	43.8	40.3	34.5
	Medium	1556	1507	1450	1388	1266	1246	989	43.6	42.2	40.6	38.9	35.4	34.9	27.7
	Low	1211	1181	1151	1062	992	911	827	33.9	33.1	32.2	29.7	27.8	25.5	23.2
230 Volt															
AHR18B	High	1145	1100	1055	1005	930	845	725	32.0	30.8	29.5	28.1	26.0	23.7	20.3
	Medium	755	750	725	665	605	485	435	21.2	21.0	20.3	18.6	16.9	13.6	12.2
	Low	680	655	625	585	540	395	300	19.0	18.3	17.5	16.4	15.1	11.1	8.4
AHR24B	High	1305	1285	1225	1175	920	915	835	36.5	36.0	34.3	32.9	25.8	25.6	23.4
	Medium	930	920	890	845	705	760	505	26.0	25.8	24.9	23.7	19.8	21.3	14.1
	Low	735	730	700	670	545	470	NA	20.6	20.4	19.6	18.8	15.3	13.2	NA
AHR30B	High	1450	1380	1300	1215	1130	1030	910	40.6	38.6	36.4	34.0	31.6	28.8	25.5
	Medium	1330	1280	1205	1135	1050	975	780	37.2	35.8	33.7	31.8	29.4	27.3	21.8
	Low	1160	1120	1065	1005	930	825	635	32.5	31.4	29.8	28.2	26.0	23.1	17.8
AHR36B	High	1470	1390	1325	1245	1155	1045	880	41.2	38.9	37.1	34.9	32.3	29.3	24.6
	Medium	1325	1265	1205	1125	1025	965	840	37.1	35.4	33.7	31.5	28.7	27.0	23.5
	Low	1115	1075	1025	950	NA	NA	NA	31.2	30.1	28.7	26.6	NA	NA	NA
AHR42C	High	1750	1670	1570	1477	1260	1125	935	49.0	46.8	44.0	41.4	35.3	31.5	26.2
	Medium	1590	1520	1435	1277	1150	1010	870	44.5	42.6	40.2	35.7	32.2	28.3	24.4
	Low	1330	1280	1200	1083	980	850	NA	37.2	35.8	33.6	30.3	27.4	23.8	NA
AHR48D	High	2005	1940	1850	1755	1650	1530	1405	56.1	54.3	51.8	49.1	46.2	42.8	39.3
	Medium	1705	1665	1605	1510	1425	1340	1185	47.7	46.6	44.9	42.3	39.9	37.5	33.2
	Low	1355	1330	1300	1245	1170	990	980	37.9	37.2	36.4	34.9	32.8	27.7	27.4
AHR60D	High	2034	1955	1858	1753	1640	1522	1296	56.9	54.8	52.0	49.1	45.9	42.6	36.3
	Medium	1733	1672	1609	1527	1431	1272	1220	48.5	46.8	45.1	42.8	40.1	35.6	34.1
	Low	1388	1359	1313	1255	1133	1004	912	38.9	38.1	36.8	35.1	31.7	28.1	25.5

1. Dry coil conditions only, tested without filters.

Air handler units are CSA listed to UL 1995/CSA C22.2 236-05 up to 0.30" w.c. external static pressure, including air filter, wet coil, and largest kW size heater, unless otherwise noted.

TABLE 16: Air Flow Data - 60 Hz Models - 208 Volt (AHE)

Models	Blower Motor Speed	CFM[1] @ External Static Pressure - IWC							m3/min @ External static pressure - Pascal						
		0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.003	0.005	0.008	0.010	0.013	0.015	0.018
208 Volt															
AHE18B	High #5	1074	1029	999	954	911	865	812	30.1	28.8	28.0	26.7	25.5	24.2	22.7
	Med High #4	895	846	802	759	701	630	526	25.1	23.7	22.5	21.3	19.6	17.6	14.7
	Med #3	663	610	556	482	334	219	173	18.6	17.1	15.6	13.5	9.4	6.1	4.8
	Med Low #2	630	466	346	196	170	67	23	17.7	13.0	9.7	5.5	4.8	1.9	0.6
	Low #1	630	466	346	196	170	67	23	17.7	13.0	9.7	5.5	4.8	1.9	0.6
AHE22B	High #5	1147	1107	1076	1040	992	942	861	32.1	31.0	30.1	29.1	27.8	26.4	24.1
	Med High #4	1009	974	941	903	859	811	762	28.3	27.3	26.3	25.3	24.0	22.7	21.3
	Med #3	826	785	744	690	639	566	501	23.1	22.0	20.8	19.3	17.9	15.9	14.0
	Med Low #2	654	590	556	479	419	307	251	18.3	16.5	15.6	13.4	11.7	8.6	7.0
	Low #1	580	491	425	317	224	189	73	16.2	13.8	11.9	8.9	6.3	5.3	2.1
AHE24B	High #5	1147	1107	1076	1040	992	942	861	32.1	31.0	30.1	29.1	27.8	26.4	24.1
	Med High #4	1009	974	941	903	859	811	762	28.3	27.3	26.3	25.3	24.0	22.7	21.3
	Med #3	826	785	744	690	639	566	501	23.1	22.0	20.8	19.3	17.9	15.9	14.0
	Med Low #2	654	590	556	479	419	307	251	18.3	16.5	15.6	13.4	11.7	8.6	7.0
	Low #1	580	491	425	317	224	189	73	16.2	13.8	11.9	8.9	6.3	5.3	2.1
AHE30B	High #5	1147	1107	1076	1040	992	942	861	32.1	31.0	30.1	29.1	27.8	26.4	24.1
	Med High #4	1009	974	941	903	859	811	762	28.3	27.3	26.3	25.3	24.0	22.7	21.3
	Med #3	826	785	744	690	639	566	501	23.1	22.0	20.8	19.3	17.9	15.9	14.0
	Med Low #2	654	590	556	479	419	307	251	18.3	16.5	15.6	13.4	11.7	8.6	7.0
	Low #1	580	491	425	317	224	189	73	16.2	13.8	11.9	8.9	6.3	5.3	2.1
AHE34C	High #5	1487	1454	1408	1350	1289	1216	1142	42.1	41.1	39.9	38.2	36.5	34.4	32.3
	Med High #4	1319	1277	1224	1156	1076	1010	937	26.8	36.2	34.7	32.7	30.5	28.6	26.5
	Med #3	1115	1061	987	912	836	767	679	31.5	30.0	27.9	25.8	23.7	21.7	19.2
	Med Low #2	948	894	790	714	636	554	517	26.8	25.3	22.4	20.2	18.0	15.7	14.6
	Low #1	869	668	504	447	393	284	NA	24.6	18.9	14.3	12.7	11.1	8.0	NA
AHE36C	High #5	1473	1417	1361	1304	1241	1171	1109	41.2	39.7	38.1	36.5	34.7	32.8	31.0
	Med High #4	1257	1204	1138	1076	1000	928	856	35.2	33.7	31.9	30.1	28.0	26.0	24.0
	Med #3	1069	997	912	831	772	697	617	29.9	27.9	25.5	23.3	21.6	19.5	17.3
	Med Low #2	994	800	705	621	554	488	432	27.8	22.4	19.7	17.4	15.5	13.7	12.1
	Low #1	904	692	411	329	256	152	NA	25.3	19.4	11.5	9.2	7.2	4.2	NA
AHE42D	High #5	1619	1577	1531	1484	1428	1372	1307	45.3	44.2	42.9	41.6	40.0	38.4	36.6
	Med High #4	1434	1391	1346	1292	1235	1164	1054	40.2	39.0	37.7	36.2	34.6	32.6	29.5
	Med #3	1243	1192	1135	1073	978	882	778	34.8	33.4	31.8	30.0	27.4	24.7	21.8
	Med Low #2	1141	1027	952	842	724	572	559	32.0	28.8	26.7	23.6	20.3	16.0	15.7
	Low #1	1025	851	465	418	253	208	123	28.7	23.8	13.0	11.7	7.1	5.8	3.4
AHE48D	High #5	1847	1812	1775	1725	1684	1645	1600	51.7	50.7	49.7	48.3	47.2	46.1	44.8
	Med High #4	1675	1640	1597	1561	1522	1479	1421	46.9	45.9	44.7	43.7	42.6	41.4	39.8
	Med #3	1436	1394	1349	1301	1246	1182	1095	40.2	39.0	37.8	36.4	34.9	33.1	30.7
	Med Low #2	1250	1211	1157	1100	1013	924	854	35.0	33.9	32.4	30.8	28.4	25.9	23.9
	Low #1	1151	1029	965	857	779	720	639	32.2	28.8	27.0	24.0	21.8	20.2	17.9
AHE60D	High #5	2083	2042	2002	1959	1921	1875	1829	58.3	57.2	56.1	54.8	53.8	52.5	51.2
	Med High #4	1893	1856	1815	1776	1728	1688	1639	53.0	52.0	50.8	49.7	48.4	47.3	45.9
	Med #3	1642	1609	1564	1512	1467	1416	1340	46.0	45.1	43.8	42.3	41.1	39.6	37.5
	Med Low #2	1443	1401	1360	1307	1242	1160	1062	40.4	39.2	38.1	36.6	34.8	32.5	29.7
	Low #1	1259	1198	1140	1067	972	900	797	35.3	33.5	31.9	29.9	27.2	25.2	22.3

1. Dry coil conditions only, tested without filters.

Air handler units are CSA listed to UL 1995/CSA C22.2 236-05 up to 0.30" w.c. external static pressure, including air filter, wet coil, and largest kW size heater, unless otherwise noted.

TABLE 17: Air Flow Data - 60 Hz Models - 230 Volt (AHE)

Models	Blower Motor Speed	CFM[1] @ External Static Pressure - IWC							m3/min @ External static pressure - Pascal						
		0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.003	0.005	0.008	0.010	0.013	0.015	0.018
230 Volt															
AHE18B	High #5	1075	1041	1003	970	930	885	842	30.1	29.1	28.1	27.2	26.0	24.8	23.6
	Med High #4	895	845	808	767	709	647	561	25.1	23.7	22.6	21.5	19.9	18.1	15.7
	Med #3	663	618	557	490	348	267	192	18.6	17.3	15.6	13.7	9.8	7.5	5.4
	Med Low #2	629	468	356	197	175	68	23	17.6	13.1	10.0	5.5	4.9	1.9	0.6
	Low #1	629	468	356	197	175	68	23	17.6	13.1	10.0	5.5	4.9	1.9	0.6
AHE22B	High #5	1156	1120	1093	1056	1014	951	862	32.4	31.4	30.6	29.6	28.4	26.6	24.1
	Med High #4	1021	987	952	918	873	836	787	28.6	27.6	26.7	25.7	24.4	23.4	22.0
	Med #3	829	789	754	698	654	585	532	23.2	22.1	21.1	19.5	18.3	16.4	14.9
	Med Low #2	681	621	575	496	435	336	262	19.1	17.4	16.1	13.9	12.2	9.4	7.3
	Low #1	598	503	437	340	259	203	74	16.7	14.1	12.2	9.5	7.3	5.7	2.1
AHE24B	High #5	1156	1120	1093	1056	1014	951	862	32.4	31.4	30.6	29.6	28.4	26.6	24.1
	Med High #4	1021	987	952	918	873	836	787	28.6	27.6	26.7	25.7	24.4	23.4	22.0
	Med #3	829	789	754	698	654	585	532	23.2	22.1	21.1	19.5	18.3	16.4	14.9
	Med Low #2	681	621	575	496	435	336	262	19.1	17.4	16.1	13.9	12.2	9.4	7.3
	Low #1	598	503	437	340	259	203	74	16.7	14.1	12.2	9.5	7.3	5.7	2.1
AHE30B	High #5	1156	1120	1093	1056	1014	951	862	32.4	31.4	30.6	29.6	28.4	26.6	24.1
	Med High #4	1021	987	952	918	873	836	787	28.6	27.6	26.7	25.7	24.4	23.4	22.0
	Med #3	829	789	754	698	654	585	532	23.2	22.1	21.1	19.5	18.3	16.4	14.9
	Med Low #2	681	621	575	496	435	336	262	19.1	17.4	16.1	13.9	12.2	9.4	7.3
	Low #1	598	503	437	340	259	203	74	16.7	14.1	12.2	9.5	7.3	5.7	2.1
AHE34C	High #5	1471	1429	1387	1337	1289	1233	1172	41.7	40.5	39.3	37.9	36.5	34.9	33.2
	Med High #4	1301	1248	1198	1147	1008	999	927	36.8	35.3	33.9	32.5	28.5	28.3	26.3
	Med #3	1097	1044	972	906	815	748	680	31.1	29.6	27.5	25.7	23.1	21.2	19.3
	Med Low #2	943	868	768	689	617	566	520	26.7	24.6	21.7	19.5	17.5	16.0	14.7
	Low #1	870	632	515	424	365	287	NA	24.6	17.9	14.6	12.0	10.3	8.1	NA
AHE36C	High #5	1465	1415	1360	1307	1246	1183	1118	41.0	39.6	38.1	36.6	34.9	33.1	31.3
	Med High #4	1260	1204	1142	1075	1008	946	876	35.3	33.7	32.0	30.1	28.2	26.5	24.5
	Med #3	1088	1022	939	862	782	721	626	30.5	28.6	26.3	24.1	21.9	20.2	17.5
	Med Low #2	998	810	717	630	562	493	444	27.9	22.7	20.1	17.6	15.7	13.8	12.4
	Low #1	903	707	411	323	265	152	NA	25.3	19.8	11.5	9.0	7.4	4.3	NA
AHE42D	High #5	1632	1589	1542	1494	1446	1391	1335	45.7	44.5	43.2	41.8	40.5	38.9	37.4
	Med High #4	1430	1390	1346	1294	1238	1168	960	40.0	38.9	37.7	36.2	34.7	32.7	26.9
	Med #3	1238	1198	1145	1082	993	908	805	34.7	33.6	32.1	30.3	27.8	25.4	22.5
	Med Low #2	1118	1020	947	851	734	666	563	31.3	28.6	26.5	23.8	20.6	18.7	15.8
	Low #1	998	772	477	418	349	NA	NA	27.9	21.6	13.4	11.7	9.8	NA	NA
AHE48D	High #5	1861	1823	1787	1750	1708	1666	1620	52.1	51.1	50.0	49.0	47.8	46.7	45.3
	Med High #4	1674	1640	1599	1562	1516	1472	1432	46.9	45.9	44.8	43.7	42.5	41.2	40.1
	Med #3	1442	1405	1358	1311	1262	1197	1108	40.4	39.3	38.0	36.7	35.3	33.5	31.0
	Med Low #2	1257	1220	1163	1103	1031	942	864	35.2	34.2	32.6	30.9	28.9	26.4	24.2
	Low #1	1153	1031	967	867	764	718	633	32.3	28.9	27.1	24.3	21.4	20.1	17.7
AHE60D	High #5	2091	2053	2016	1975	1937	1906	1869	58.5	57.5	56.4	55.3	54.2	53.4	52.3
	Med High #4	1903	1868	1832	1791	1748	1703	1660	53.3	52.3	51.3	50.1	49.0	47.7	46.5
	Med #3	1634	1598	1562	1516	1468	1422	1350	45.8	44.7	43.7	42.4	41.1	39.8	37.8
	Med Low #2	1447	1404	1361	1318	1257	1164	1092	40.5	39.3	38.1	36.9	35.2	32.6	30.6
	Low #1	1268	1203	1148	1073	978	907	839	35.5	33.7	32.1	30.0	27.4	25.4	23.5

1. Dry coil conditions only, tested without filters.

Air handler units are CSA listed to UL 1995/CSA C22.2 236-05 up to 0.30" w.c. external static pressure, including air filter, wet coil, and largest kW size heater, unless otherwise noted.

SECTION IX: MAINTENANCE

Filters must be cleaned or replaced when they become dirty. Inspect at least once per month. The frequency of cleaning depends upon the hours of operation and the local atmospheric conditions. Clean filters keep unit efficiency high.

COIL CLEANING

If the coil needs to be cleaned, it should be wash with a evaportor coil cleaner. Follow directions from coil cleaner.

LUBRICATION

The bearings of the blower motor are permanently lubricated.

CONDENSATE DRAINS

During the cooling season check the condensate drain lines to be sure that condensate is flowing from the primary drain but not from the secondary drain. If condensate ever flows from the secondary drain the unit should be promptly shut off and the condensate pan and drains cleaned to insure a free flowing primary drain.

SECTION X: WIRING DIAGRAM

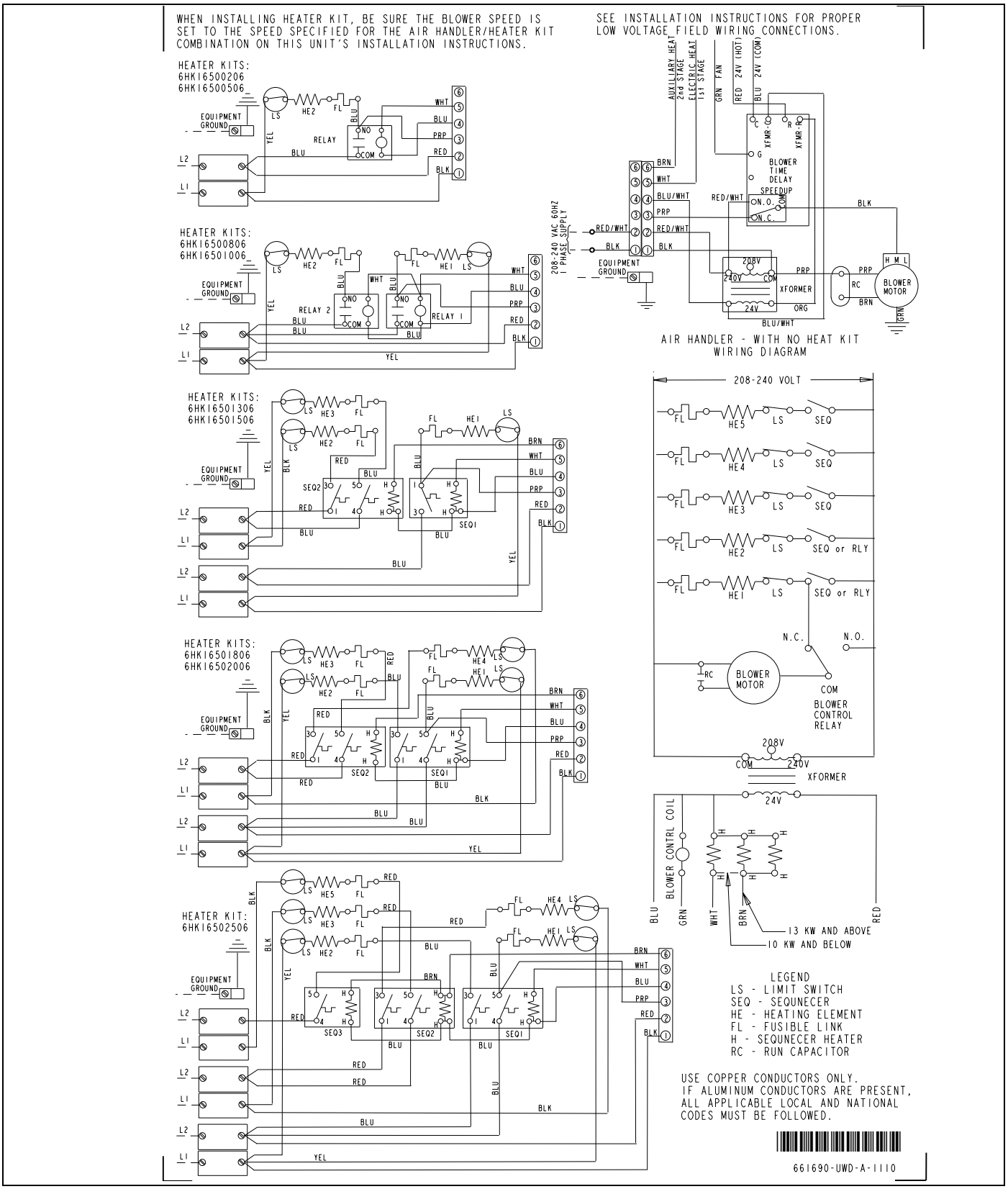

WHEN INSTALLING HEATER KIT, BE SURE THE BLOWER SPEED IS SET TO THE SPEED SPECIFIED FOR THE AIR HANDLER/HEATER KIT COMBINATION ON THIS UNIT'S INSTALLATION INSTRUCTIONS.
SEE INSTALLATION INSTRUCTIONS FOR PROPER LOW VOLTAGE FIELD WIRING CONNECTIONS.
HEATER KITS: 6HK16500206 6HK16500506
HEATER KITS: 6HK16500806 6HK16501006
HEATER KITS: 6HK16501306 6HK16501506
HEATER KITS: 6HK16501806 6HK16502006
HEATER KIT: 6HK16502506
AIR HANDLER - WITH NO HEAT KIT WIRING DIAGRAM
208-240 VOLT
BLOWER CONTROL RELAY
XFORMER
13 KW AND ABOVE
10 KW AND BELOW
LEGEND
LS - LIMIT SWITCH
SEQ - SEQUNECER
HE - HEATING ELEMENT
FL - FUSIBLE LINK
H - SEQUNECER HEATER
RC - RUN CAPACITOR
USE COPPER CONDUCTORS ONLY.
IF ALUMINUM CONDUCTORS ARE PRESENT, ALL APPLICABLE LOCAL AND NATIONAL CODES MUST BE FOLLOWED.
661690-UWD-A-1110

FIGURE 15: Wiring Diagram - PSC - Single Phase Heat Kits

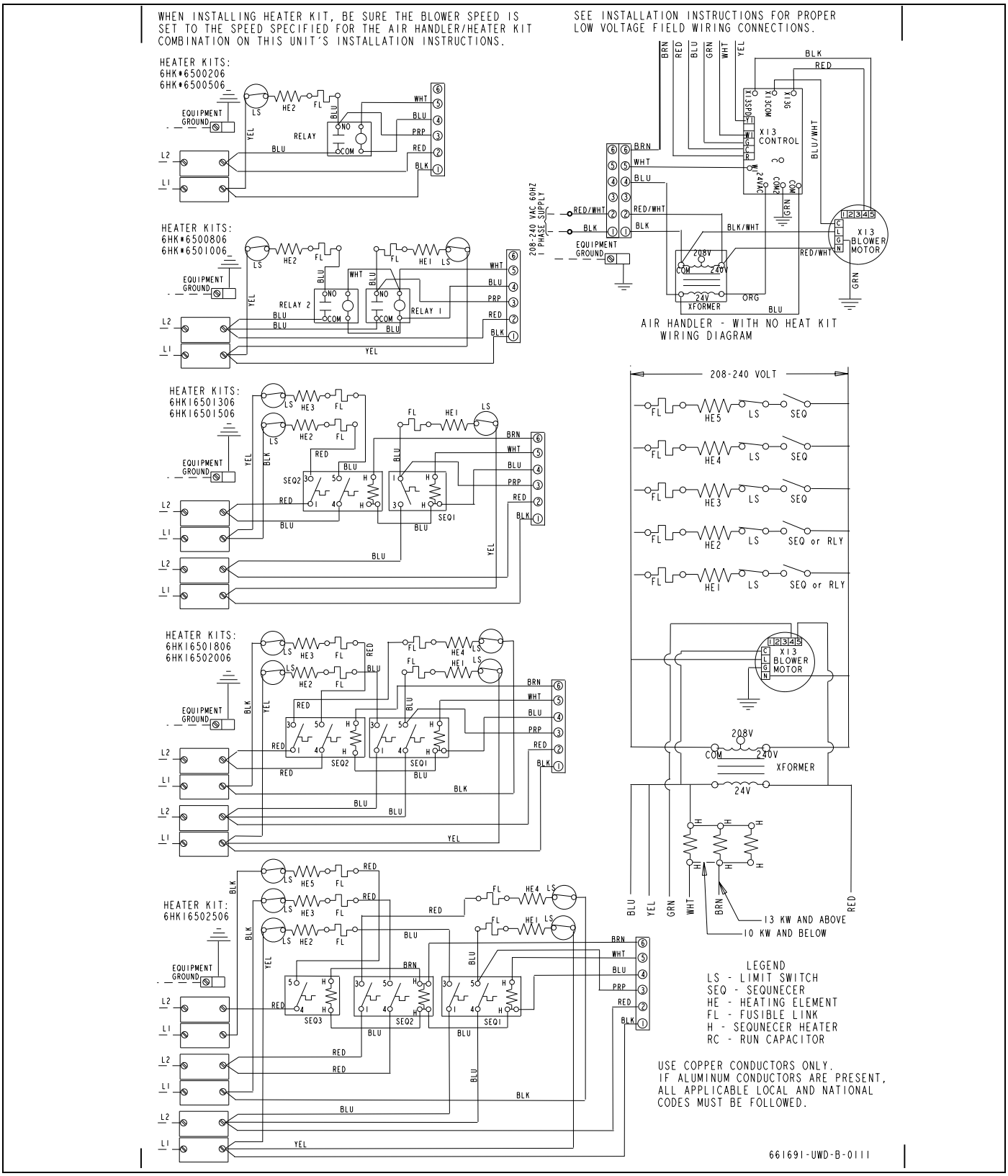


FIGURE 16: Wiring Diagram - ECM - Single Phase Heat Kits

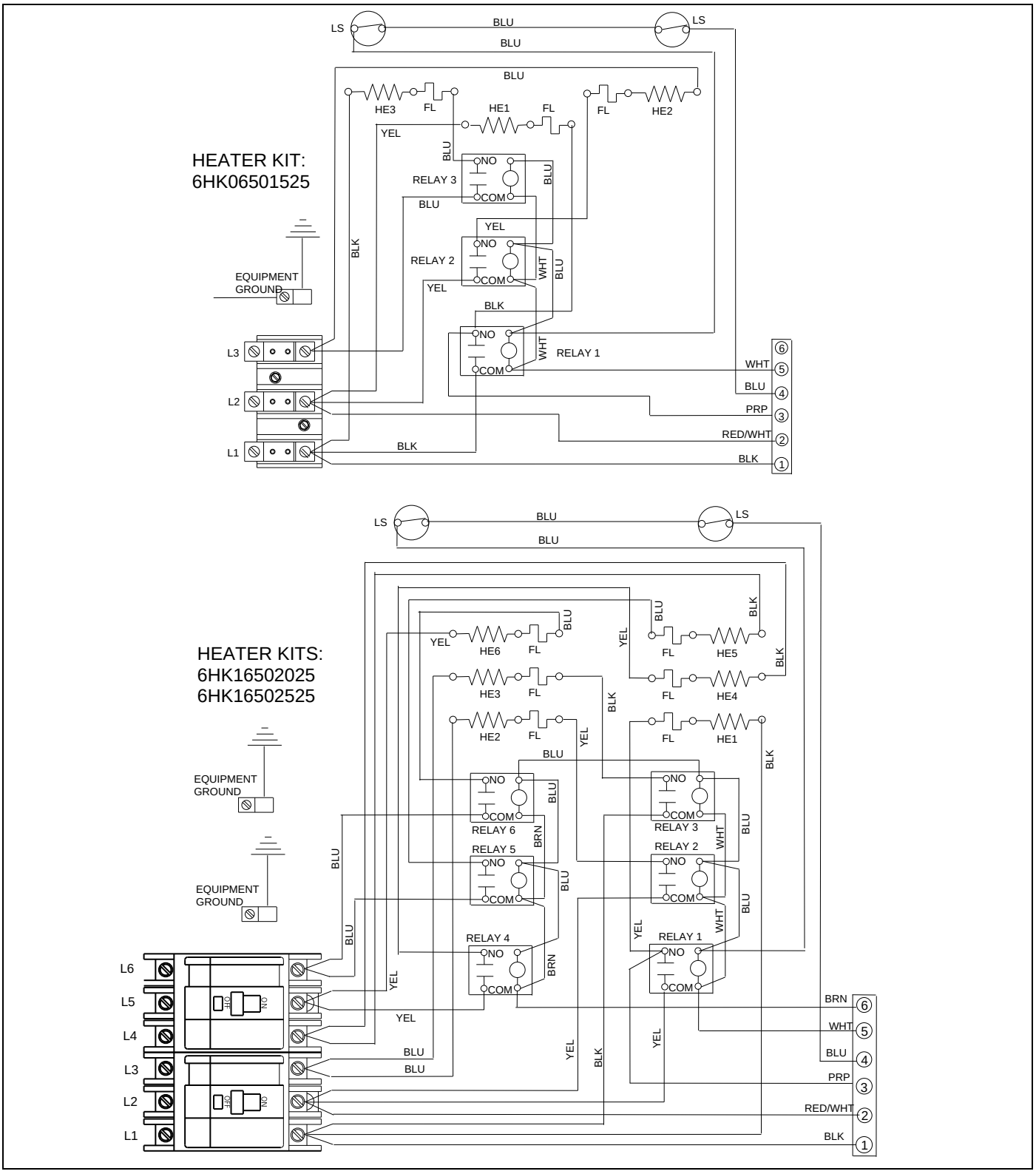


FIGURE 17: Wiring Diagram - ECM - 3 Phase Heat Kits

SECTION XI: TYPICAL THERMOSTAT CONNECTIONS

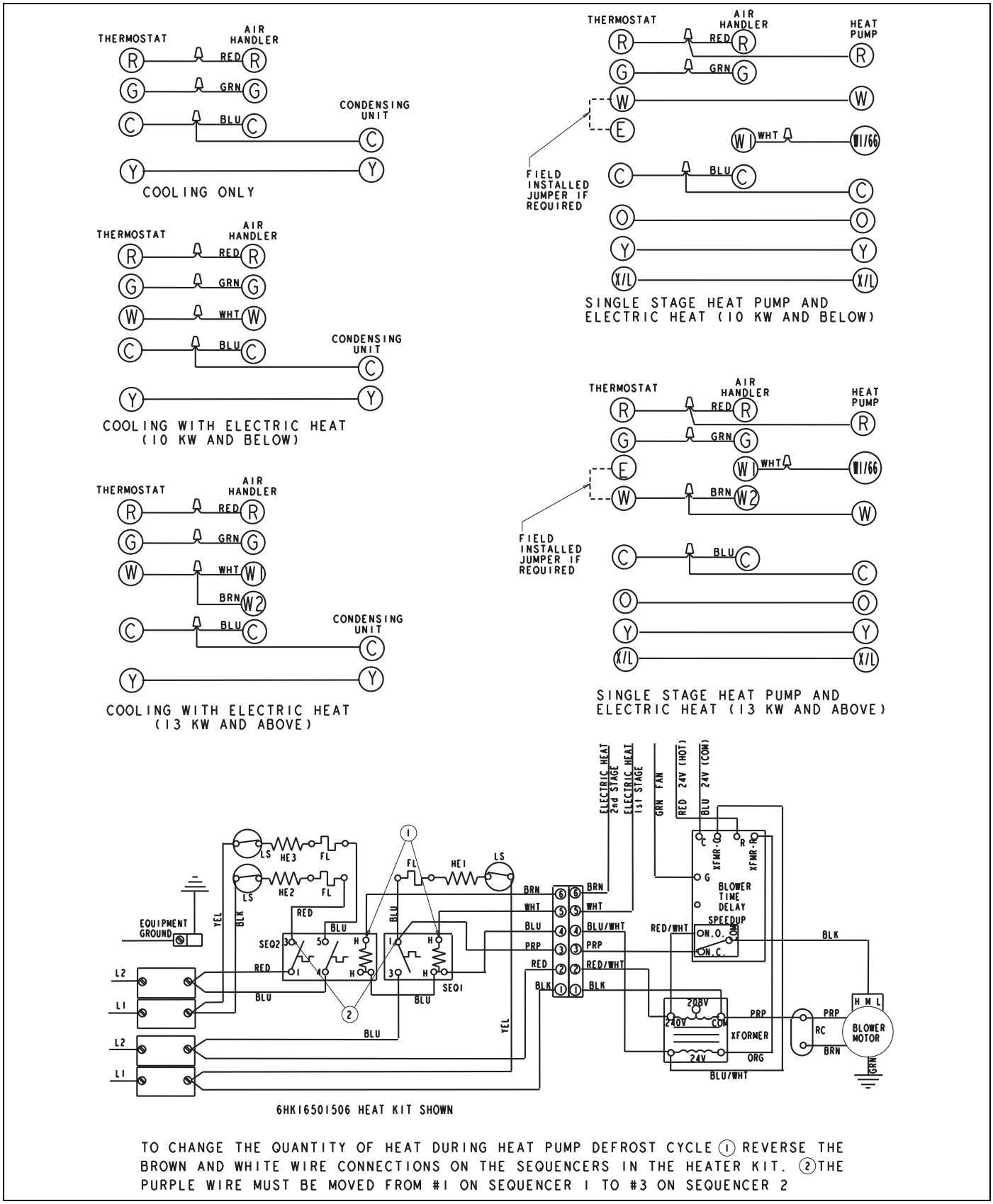


FIGURE 18: Typical Wiring Diagram - PSC

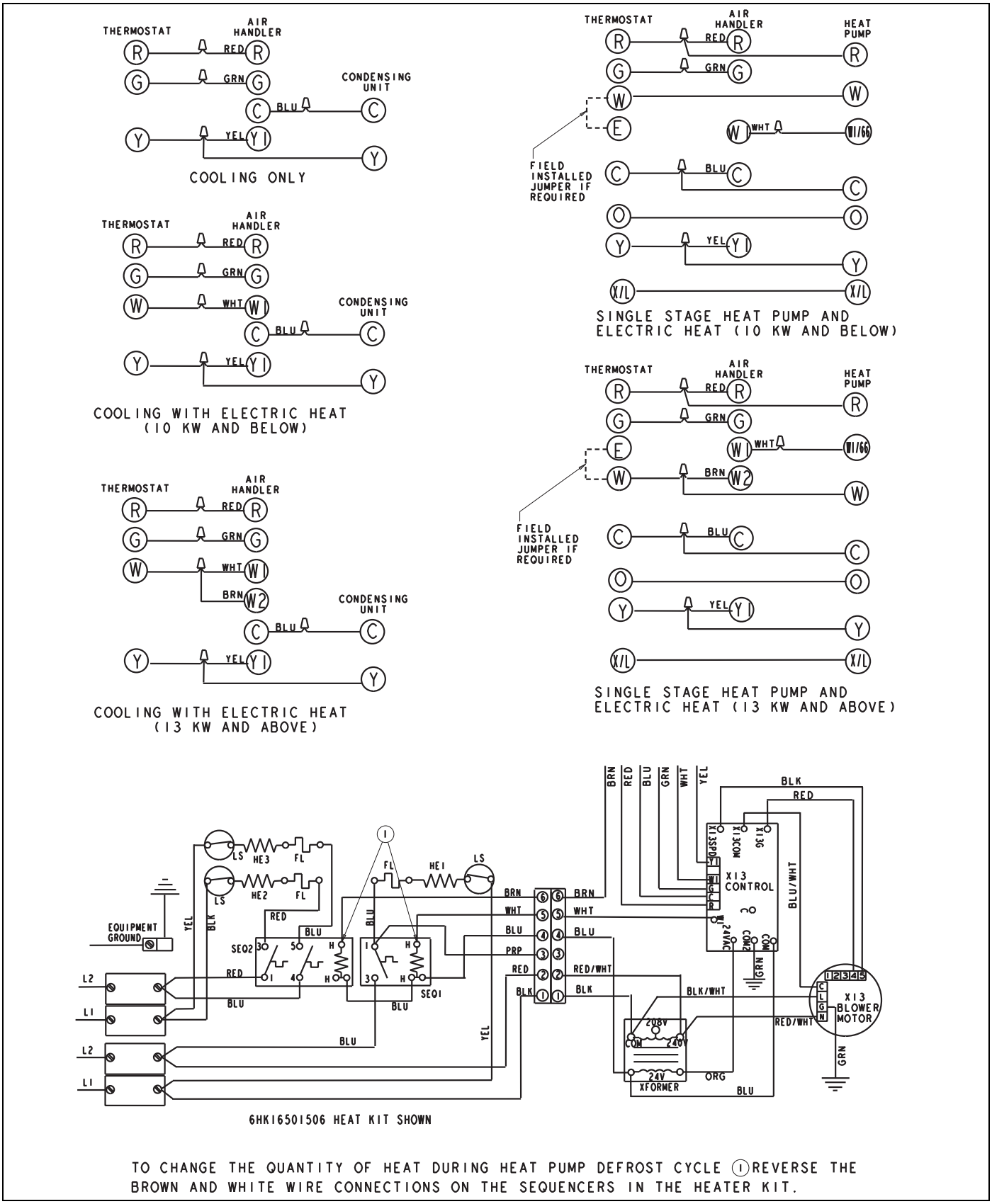


FIGURE 19: Typical Wiring Diagram - ECM

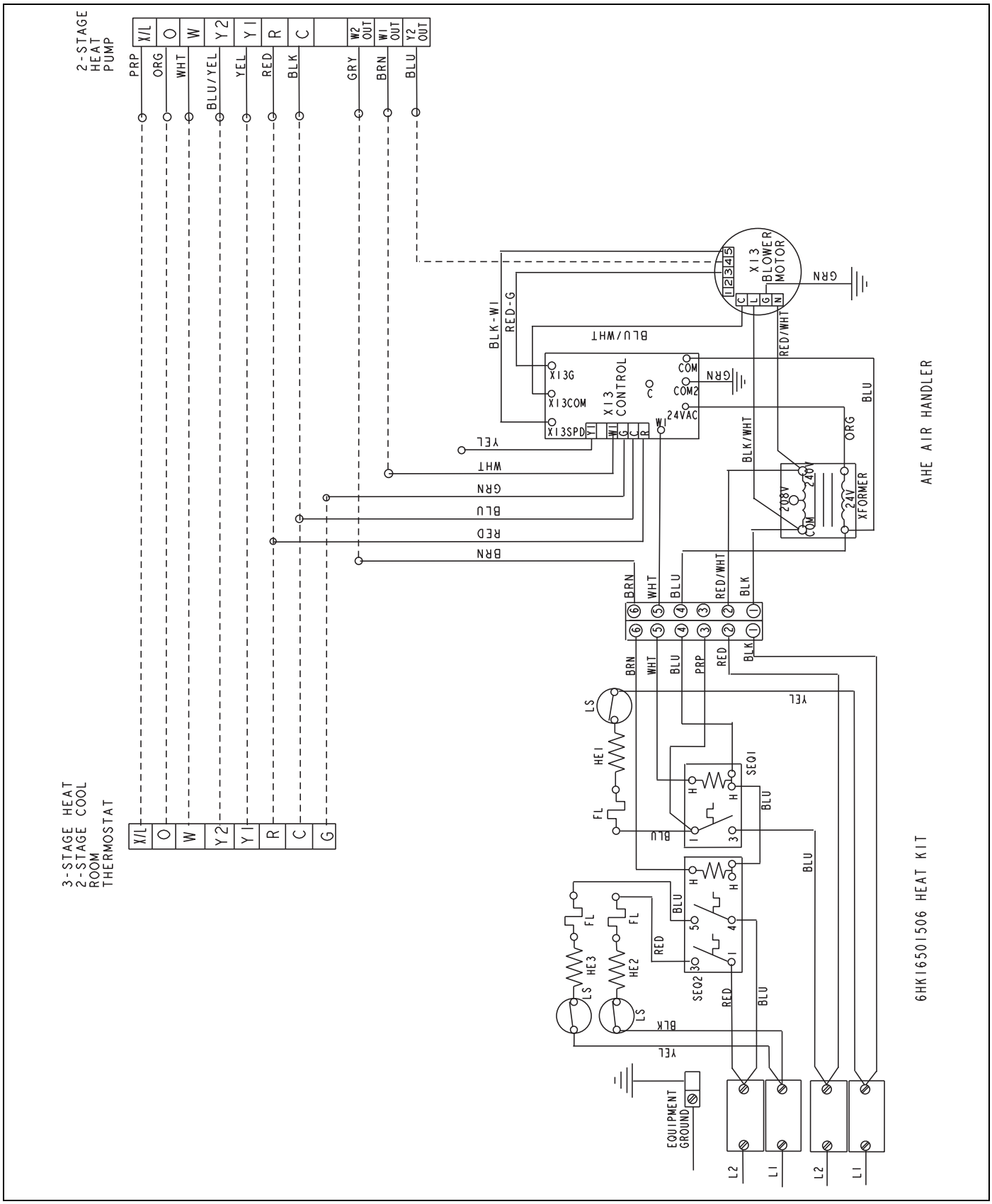


FIGURE 20: Typical Thermostat Wiring for 2-Stage Heat Pump with ECM Blower Motor - ECM

.Subject to change without notice. Published in U.S.A
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697883-UIM-A-0711
Supersedes: 661693-UIM-C-0311

Johnson Controls Unitary Products
5005 York Drive
Norman, OK 73069

O&M SECTION SHEET

SECTION: 2
PRODUCT: ROOFTOP UNITS

Paulson-Cheek Mechanical, Inc.
6145 Norhtbelt Parkway, Suite F
Norcross, GA 30071

PHONE: 770-729-0076
FAX: 770-729-1076

PROJECT: **Pinewood Atlanta - Phase 1A**
Stage 9
LOCATION: **Fayetteville, GA**

Paulson-Cheek Mechanical, Inc.

ARCHITECT'S/ENGINEER'S STAMP

Paulson-Cheek Mechanical, Inc.

DATE RECEIVED:	06/12/14
MANUFACTURER:	JCI
SUPPLIER:	JCI
SUBMITTED DATE:	06/12/14

[X] NO ERRORS DETECTED

[ ] CORRECT EXCEPTIONS NOTED

THIS APPROVAL OF SHOP DRAWINGS DOES NOT RELIEVE THE SUBCONTRACTOR OR VENDOR FROM THE REQUIREMENTS OF THE CONTRACT DOCUMENTS.

CHECKED BY:	William Hagler
DATE CHECKED:	06/12/14

INSTALLATION MANUAL

R-410A
SERIES 20 JZJ**

15 - 25 Ton

60 Hertz

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General

Johnson Controls Series 20 J**ZJ models are either single package air conditioners equipped with optional factory installed electric heaters, or single package gas-fired central heating furnaces with cooling unit. Both are designed for outdoor installation on a rooftop or slab.

The units are completely assembled on rigid, permanently attached base rails. All piping, refrigerant charge, and electrical wiring is factory installed and tested. The units require electric power, gas connection, duct connections, installation of combustion air inlet hood, flue gas outlet hoods and fixed outdoor air intake damper (units without economizer or motorized damper option only) at the point of installation.

The supplemental electric heaters have nickel-chrome elements and utilize single point power connection.

These gas-fired heaters have aluminized-steel or optional stainless steel, tubular heat exchangers with spark ignition with proven pilot. All gas heaters are shipped from the factory equipped for natural gas use, but can be field converted to L.P./Propane with Kit Model # 1NP0418. See Gas Heat Application Data Table.

Safety Considerations

This is a safety alert symbol. When you see this symbol on labels or in manuals, be alert to the potential for personal injury.

Understand and pay particular attention the signal words **DANGER**, **WARNING** or **CAUTION**.

DANGER indicates an **imminently** hazardous situation, which, if not avoided, **will result in death or serious injury.**

WARNING indicates a **potentially** hazardous situation, which, if not avoided, **could result in death or serious injury.**

CAUTION indicates a potentially hazardous situation, which, if not avoided **may result in minor or moderate injury.** It is also used to alert against unsafe practices and hazards involving only property damage.

⚠WARNING

Improper installation may create a condition where the operation of the product could cause personal injury or property damage. Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage. Refer to this manual for assistance or for additional information, consult a qualified contractor, installer or service agency.

⚠ CAUTION

This product must be installed in strict compliance with the installation instructions and any applicable local, state and national codes including, but not limited to building, electrical, and mechanical codes.

⚠WARNING

Before performing service or maintenance operations on unit, turn off main power switch to unit. Electrical shock could cause personal injury. Improper installation, adjustment, alteration, service or maintenance can cause injury or property damage. Refer to this manual. For assistance or additional information consult a qualified installer, service agency or the gas supplier.

⚠ CAUTION

This system uses R-410A Refrigerant which operates at higher pressures than R-22. No other refrigerant may be used in this system. Gage sets, hoses, refrigerant containers and recovery systems must be designed to handle R-410A. If you are unsure, consult the equipment manufacturer. Failure to use R-410A compatible servicing equipment may result in property damage or injury.

⚠WARNING

If the information in this manual is not followed exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.

WHAT TO DO IF YOU SMELL GAS:

a. Do not try to light any appliance.

b. Do not touch any electrical switch; do not use any phone in your building.

c. Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.

d. If you cannot reach your gas supplier, call the fire department.

Installation and service must be performed by a qualified installer, service agency or the gas supplier.

Due to system pressure, moving parts, and electrical components, installation and servicing of air conditioning equipment can be hazardous. Only qualified, trained service personnel should install, repair, or service this equipment. Untrained personnel can perform basic maintenance functions of cleaning coils and filters and replacing filters.

Observe all precautions in the literature, labels, and tags accompanying the equipment whenever working on air conditioning equipment. Be sure to follow all other applicable safety precautions and codes including ANSI Z223.1 or CSA-B149.1- latest edition.

Wear safety glasses and work gloves. Use quenching cloth and have a fire extinguisher available during brazing operations.

Inspection

As soon as a unit is received, it should be inspected for possible damage during transit. If damage is evident, the extent of the damage should be noted on the carrier's freight bill. A separate request for inspection by the carrier's agent should be made in writing.

⚠ CAUTION

This product must be installed in strict compliance with the enclosed installation instructions and any applicable local, state and national codes including, but not limited to, building, electrical, and mechanical codes.

The furnace and its individual shut-off valve must be disconnected from the gas supply piping system during any pressure testing at pressures in excess of 1/2 PSIG.

Pressures greater than 1/2 PSIG will cause gas valve damage resulting in a hazardous condition. If it is subjected to a pressure greater than 1/2 PSIG, the gas valve must be replaced.

The furnace must be isolated from the gas supply piping system by closing its individual manual shut-off valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 PSIG.

Reference

Additional information is available in the following reference forms:

- Technical Guide - J15 thru 25 ZJ/ZR/ZF, 349690
- General Installation - J15 thru 25 ZJ, 860261

Renewal Parts

For authorized replacement parts call Johnson Controls, Inc. National Source 1 Parts outlet at 1-866-523-9670.

Approvals

Design certified by CSA as follows:

1. For use as a cooling only unit, cooling unit with supplemental electric heat or a forced air furnace.
2. For outdoor installation only.
3. For installation on combustible material.
4. For use with natural gas (convertible to LP with kit).

⚠ CAUTION

This product must be installed in strict compliance with the enclosed installation instructions and any applicable local, state, and national codes including, but not limited to, building, electrical, and mechanical codes.

⚠WARNING

Improper installation may create a condition where the operation of the product could cause personal injury or property damage.

⚠ CAUTION

This system uses R-410A Refrigerant which operates at higher pressures than R-22. No other refrigerant may be used in this system.

Nomenclature

15-25 Ton Series 20 Model Number Nomenclature

J15	Z	J	N24	A	2	A	AA	1	0	1	2	4	A

Nominal Cooling Capacity

J15 = 15 Ton
J18 = 17.5 Ton
J20 = 20 Ton
J25 = 25 Ton

Product Category

Z = A/C, Single Pkg., R-410A

Product Identifier

J = 11.0+ EER A/C

Heat Type and Nominal Heat Capacity

C00 = Cooling Only. No field installed electric heat

Gas Heat Options

N24 = 240 MBH Output Aluminized Steel
N32 = 320 MBH Output Aluminized Steel
S24 = 240 MBH Output Stainless Steel
S32 = 320 MBH Output Stainless Steel

Electric Heat Options

E18 = 18 KW
E36 = 36 KW
E54 = 54 KW
E72 = 72 KW

Airflow

A = Std. Motor
B = Std. Motor/Economizer
C = Std. Motor/Economizer/Power Exhaust (Downflow Only)
D = Std. Motor/Motorized Damper
E = Std. Motor/Motorized Damper/Barometric Relief
J = Std. Motor/Economizer/Barometric Relief
N = Hi Static
P = Hi Static/Economizer
Q = Hi Static/Economizer/Power Exhaust (Downflow Only)
R = Hi Static/Motorized Damper
K = Hi Static/Motorized Damper/Barometric Relief
S = Hi Static/Economizer/Barometric Relief
2 = Low Static
3 = Low Static/Economizer
4 = Low Static/Economizer/Power Exhaust (Downflow Only)
5 = Low Static/Motorized Damper
6 = Low Static/Motorized Damper/Barometric Relief
7 = Low Static/Economizer/Barometric Relief

Voltage

2 = 208/230-3-60
4 = 460-3-60
5 = 575-3-60

Product Style

A = Style A

Configuration Options (not required for all units)
These four digits will not be assigned until a quote is requested, or an order placed.

- SS Drain Pan
- Johnson UNT 1126 Controller (N2 protocol), DFS, APS
- Johnson Commercial Controls System (CCS) Rtu Controller
- Johnson Controller Metasys FEC-2611 (BACnet MS/TP Protocol), SAS, RAS, OAS, DFS, APS
- CPC Controller, DFS, APS
- Honeywell Controller, DFS, APS
- Novar Controller, DFS, APS
- Simplicity IntelliComfort II Controller
- Simplicity IntelliComfort II Controller w/Simplicity™LINC
- Hot Gas Bypass (Standard on VAV, Optional on CV)
- Variable Air Volume, VFD
- Variable Air Volume, VFD and Manual Bypass
- Variable Air Volume, VFD (BAS ready - for customer provided VFD controller)
- Variable Air Volume, VFD and Manual Bypass (BAS ready)
- Variable Air Volume, VFD Ready (for customer provided, field installed drive)
- 2" Pleated Filters, MERV 7
- 4" Pleated Filters, MERV 13
- BAS Ready Economizer (2-10 V.D.C. Actuator without a controller)
- Double Wall Construction

For valid combinations of the above; see the equipment price pages or the Unitary Sales Tool program; all combinations are not available

Product Generation

1 = First Generation

Additional Options

Standard Cabinet	Hinged Filter Door & Tool Free Access Cabinet
AA = None AB = Phase Monitor AC = Coil Guard AD = Dirty Filter Switch AE = Phase Monitor & Coil Guard AF = Phase Monitor & Dirty Filter Switch AG = Coil Guard & Dirty Filter Switch AH = Phase Monitor, Coil Guard & Dirty Filter Switch RC = Coil Guard & American Flag TA = Technicoat Condenser Coil TJ = Technicoat Evaporator Coil TS = Technicoat Evaporator & Condenser Coils EA = ElectroFin Condenser Coil EJ = ElectroFin Evaporator Coil ES = ElectroFin Cond & Evap Coils	BA = Hinged Filter Door & Tool Free Access Panels BB = Phase Monitor, Hinged Filter Door & Tool Free Access Panels BC = Coil Guard, Hinged Filter Door & Tool Free Access Panels BD = Dirty Filter Switch, Hinged Filter Door & Tool Free Access Panels BE = Phase Monitor & Coil Guard, Hinged Filter Door & Tool Free Access Panels BF = Phase Monitor & Dirty Filter Switch, Hinged Filter Door & Tool Free Access Panels BG = Coil Guard & Dirty Filter Switch, Hinged Filter Door & Tool Free Access Panels BH = Phase Monitor, Coil Guard & Dirty Filter Switch, Hinged Filter Door & Tool Free Access Panels

ZZ = If desired option combination is not listed above, ZZ will be assigned and configuration options will be located in digits 15-18.

Installation Options

A = No Options Installed B = Option 1 C = Option 2 D = Options 1 & 2 E = Option 3 F = Option 4 G = Options 1 & 3 H = Options 1 & 4 J = Options 1, 2 & 3 K = Options 1, 2, & 4 L = Options 1,3 & 4 M = Options 1, 2, 3, & 4	N = Options 2 & 3 P = Options 2 & 4 Q = Options 2, 3, & 4 R = Options 3 & 4 S = Option 5 T = Options 1 & 5 U = Options 1, 3, & 5 V = Options 1, 4, & 5 W = Options 1, 3, 4, & 5 X = Options 3 & 5 Y = Options 4 & 5 Z = Options 3, 4 & 5

Options

1 = Disconnect 2 = Non-Pwr'd Conv. Outlet 3 = Smoke Detector S.A.	4 = Smoke Detector R.A. 5 = Pwr'd Conv. Outlet

Installation

Installation Safety Information

Read these instructions before continuing this appliance installation. This is an outdoor combination heating and cooling unit. The installer must assure that these instructions are made available to the consumer and with instructions to retain them for future reference.

1. Refer to the unit rating plate for the approved type of gas for this product.
2. Install this unit only in a location and position as specified on Page 7 of these instructions.
3. Never test for gas leaks with an open flame. Use commercially available soap solution made specifically for the detection of leaks when checking all connections, as specified on Pages 5, 28 and 52 of these instructions.
4. Always install furnace to operate within the furnace's intended temperature-rise range with the duct system and within the allowable external static pressure range, as specified on the unit name/rating plate, specified on Page 27 of these instructions.
5. This equipment is not to be used for temporary heating of buildings or structures under construction.

⚠WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow the safety warning exactly could result in serious injury, death or property damage.

Never test for gas leaks with an open flame. use a commercially available soap solution made specifically for the detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury or loss of life.

6. If a factory option convenience outlet is installed, the weatherproof outlet cover must be field installed. The cover shall be located in the unit control box. To install the cover, remove the shipping label covering the convenience outlet, follow the instructions on the back of the weatherproof cover box, and attach the cover to the unit using the (4) screws provided.

⚠ CAUTION

208/230-3-60 and 380/415-3-50 units with factory installed Powered Convenience Outlet Option are wired for 230v and 415v power supply respectively. Change tap on transformer for 208-3-60 or 380-3-50 operation. See unit wiring diagram.

Limitations

These units must be installed in accordance with the following:

In U.S.A.:

1. National Electrical Code, ANSI/NFPA No. 70 - Latest Edition
2. National Fuel Gas Code, ANSI Z223.1 - Latest Edition
3. Gas-Fired Central Furnace Standard, ANSI Z21.47a. - Latest Edition
4. Local building codes, and
5. Local gas utility requirements

In Canada:

1. Canadian Electrical Code, CSA C22.1
2. Installation Codes, CSA - B149.1.
3. Local plumbing and waste water codes, and
4. Other applicable local codes.

Refer to unit application data found in this document.

After installation, gas fired units must be adjusted to obtain a temperature rise within the range specified on the unit rating plate.

If components are to be added to a unit to meet local codes, they are to be installed at the dealer's and/or customer's expense.

Size of unit for proposed installation should be based on heat loss/heat gain calculation made according to the methods of Air Conditioning Contractors of America (ACCA).

This furnace is not to be used for temporary heating of buildings or structures under construction.

⚠ CAUTION

The control board used in this product will effectively operate the cooling system down to 0°F when this product is applied in a comfort cooling application for people. An economizer is typically included in this type of application. When applying this product for process cooling applications (computer rooms, switchgear, etc.), please reference applications bulletin AE-011-07 or call the applications department for Unitary Products @ 1-877-UPG-SERV for guidance. Additional accessories may be needed for stable operation at temperatures below 30°F.

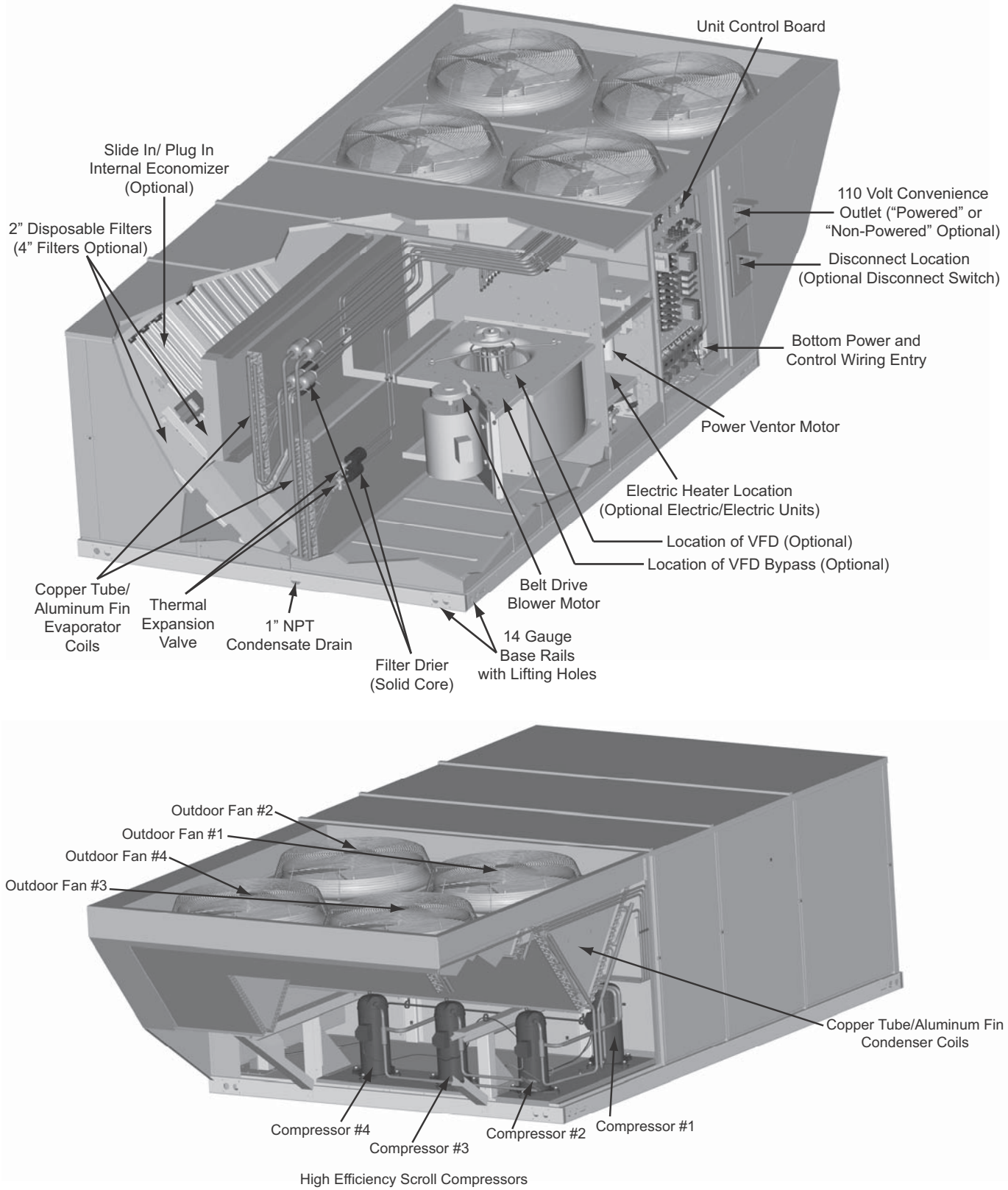


Figure 1: J15 thru 25 ZJ Component Location

Table 1: J15 thru 25 ZJ Unit Limitations

Size (Tons)	Unit Voltage	Unit Limitations		
		Applied Voltage		Outdoor DB Temp
		Min	Max	Max (°F)
J15 (15)	208/230-3-60	187	252	125
	460-3-60	432	504	125
	575-3-60	540	630	125
J18 (17.5)	208/230-3-60	187	252	125
	460-3-60	432	504	125
	575-3-60	540	630	125
J20 (20)	208/230-3-60	187	252	125
	460-3-60	432	504	125
	575-3-60	540	630	125
J25 (25)	208/230-3-60	187	252	125
	460-3-60	432	504	125
	575-3-60	540	630	125

Location

Use the following guidelines to select a suitable location for these units:

1. Unit is designed for *outdoor installation only*.
2. Condenser coils must have an unlimited supply of air. Where a choice of location is possible, position the unit on either north or east side of building.
3. Suitable for mounting on roof curb.
4. For ground level installation, use a level concrete slab with a minimum thickness of 4 inches. The length and width should be at least 6 inches greater than the unit base rails. Do not tie slab to the building foundation.
5. Roof structures must be able to support the weight of the unit and its options/accessories. Unit must be installed on a solid, level roof curb or appropriate angle iron frame.
6. Maintain level tolerance to 1/2” across the entire width and length of unit.

⚠WARNING

Excessive exposure of this furnace to contaminated combustion air may result in equipment damage or personal injury. Typical contaminates include: permanent wave solution, chlorinated waxes and cleaners, chlorine based swimming pool chemicals, water softening chemicals, carbon tetrachloride, Halogen type refrigerants, cleaning solvents (e.g. perchloroethylene), printing inks, paint removers, varnishes, hydrochloric acid, cements and glues, antistatic fabric softeners for clothes dryers, masonry acid washing materials.

Clearances

All units require particular clearances for proper operation and service. Installer must make provisions for adequate combustion and ventilation air in accordance with section 5.3 of Air for Combustion and Ventilation of the National Fuel Gas Code, ANSI Z223.1 – Latest Edition (in U.S.A.), or Sections 7.2, 7.3, or 7.4 of Gas Installation Codes, CSA-B149.1 (in Canada) - Latest Edition, and/or applicable provisions of the local building codes. Refer to Table 6 for clearances required for combustible construction, servicing, and proper unit operation.

⚠WARNING

Do not permit overhanging structures or shrubs to obstruct condenser air discharge outlet, combustion air inlet or vent outlets.

Rigging And Handling

Exercise care when moving the unit. Do not remove any packaging until the unit is near the place of installation. Rig the unit by attaching chain or cable slings to the lifting holes provided in the base rails. Spreader bars, whose length exceeds the largest dimension across the unit, **MUST** be used across the top of the unit.

⚠ CAUTION

If a unit is to be installed on a roof curb other than a Unitary Products roof curb, gasketing must be applied to all surfaces that come in contact with the unit underside.

⚠ CAUTION

Before lifting, make sure the unit weight is distributed equally on the rigging cables so it will lift evenly.

Units may be moved or lifted with a forklift, from the side only, providing an accessory skid is used.

LENGTH OF FORKS MUST BE A MINIMUM OF 90 INCHES.

⚠ CAUTION

All panels must be secured in place when the unit is lifted.

The condenser coils should be protected from rigging cable damage with plywood or other suitable material.

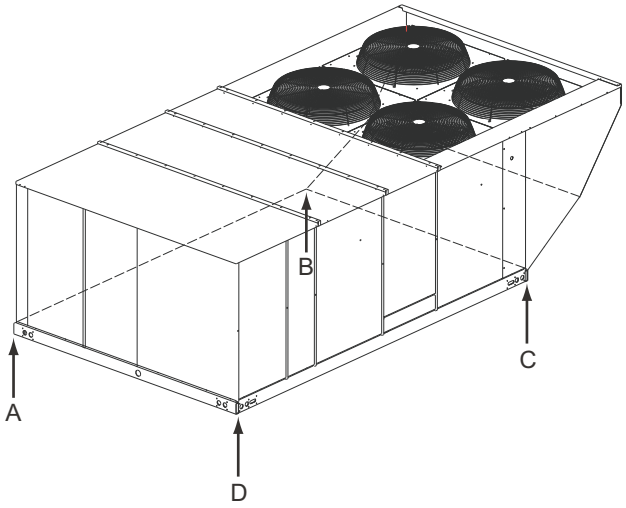


Figure 2: Unit 4 Point Load Weight

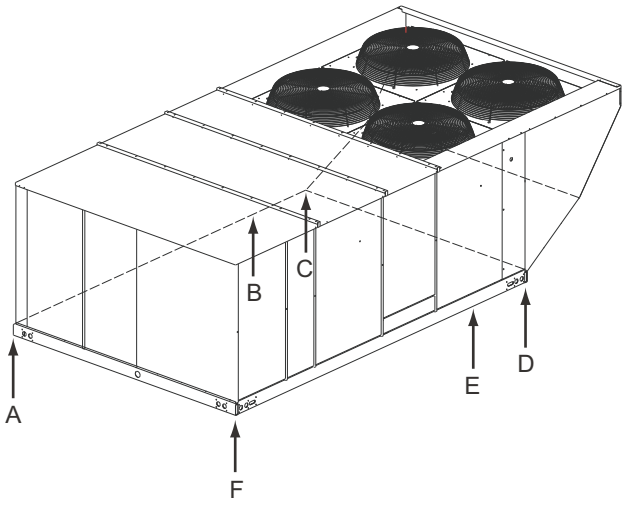


Figure 3: Unit 6 Point Load Weight

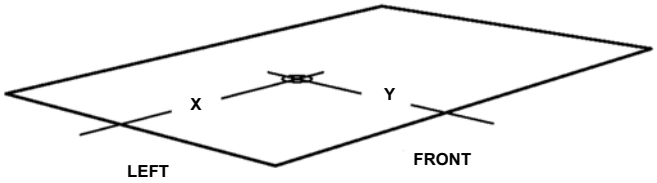


Figure 4: Center of Gravity

Table 2: Weights and Dimensions

Size	Weight (lbs.)		Center of Gravity		4 Point Load Location (lbs.)				6 Point Load Location (lbs.)					
(Tons)	Shipping	Operating	X	Y	A	B	C	D	A	B	C	D	E	F
J15ZJ (15)	2614	2609	85.25	44	467	781	852	510	287	392	568	620	428	313
J18ZJ (17.5)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
J20ZJ (20)	2702	2697	85.05	44	485	805	878	529	298	406	585	638	443	326
J25ZJ (25)	2788	2783	85.25	44	498	833	908	544	306	419	606	661	457	334

Table 3: J15 thru 25 ZJ Unit Accessory Weights

Unit Accessory	Weight (lbs.)	
	Shipping	Operating
Economizer	165	160
Power Exhaust	90	85
Electric Heat[1]	40	40
Gas Heat[2]	240	240
Double Wall	260	260
Motorized Damper	150	150
Barometric Damper	50	45
Econ./Motorized Damper Rain Hood	60	55
Econ./Power Exhaust Rain Hood	95	90
Wood Skid	220	220
Roof Curb	190	185
Hot Gas Bypass	10	10
Supply Fan VFD	See Table 5	

1. Weight given is for the maximum heater size available (54KW).
2. Weight given is for the maximum number of tube heat exchangers available (8 tube).

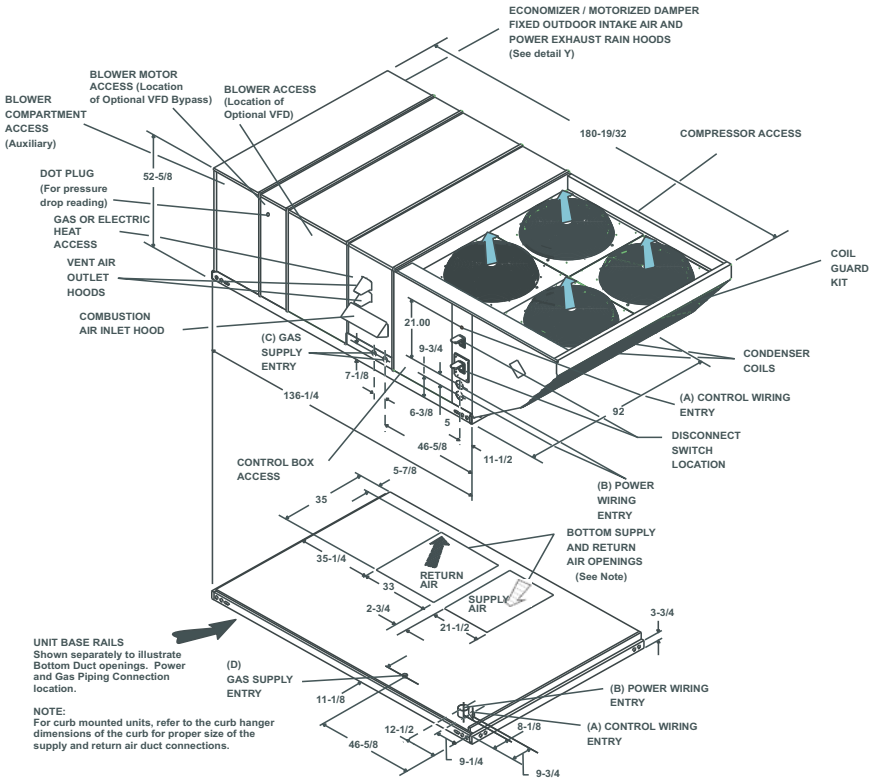


Figure 5: J15 thru 25 ZJ Unit Dimensions Front View

Table 4: Utilities Entry

Hole	Opening Size Diameter	Used For	
A	1-1/8" KO	Control Wiring	Front
	3/4" NPS (Fem.)		Bottom
B	3-5/8" KO	Power Wiring	Front
	3" NPS (Fem.)		Bottom
C	2-3/8" KO	Gas Piping (Front)[1]	
D	1-11/16" Hole	Gas Piping (Bottom)[1,2]	

1. One-inch Gas Piping NPT Required.
2. Opening in the bottom to the unit can be located by the slice in the insulation.

Note: All entry holes should be sealed to prevent rain water entry into building.

Table 5: Supply Fan VFD Weights, In Lbs.

Supply Fan Motor	230V	460V	575V
W/O Manual Bypass			
5.0 hp	25	25	30
7.5 hp	30	30	30
10.0 hp	30	30	35
15.0 hp	30	30	40
W/Manual Bypass			
5.0 hp	30	30	35
7.5 hp	35	35	35
10.0 hp	35	35	40
15.0 hp	40	35	45

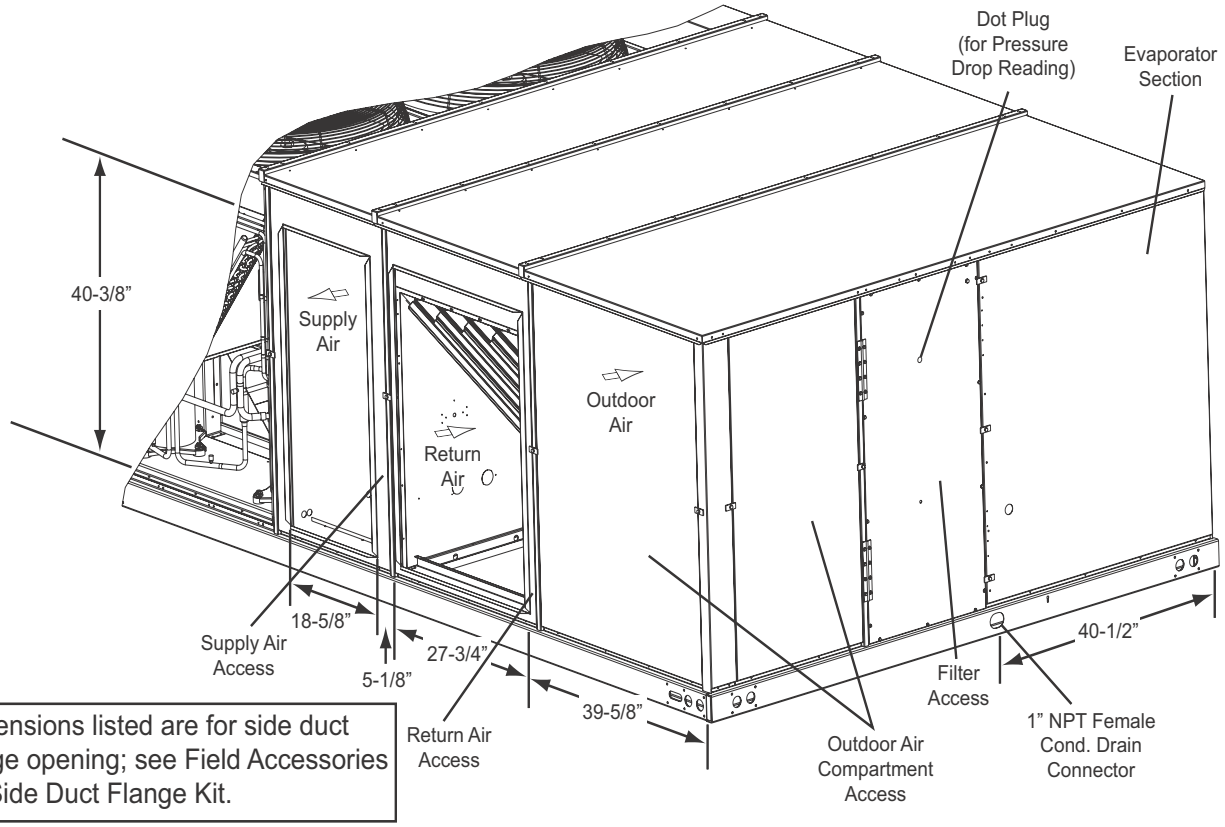


Figure 6: J15 thru 25 ZJ Unit Dimensions Rear View

NOTE: Units are shipped with the bottom duct openings covered. An accessory flange kit is available for connecting side ducts.

For <u>bottom</u> duct applications:

1. Remove the side panels from the supply and return air compartments to gain access to the bottom supply and return air duct covers.
2. Remove and discard the bottom duct covers. Duct openings are closed with sheet metal covers except when the unit includes a power exhaust option. The covering consists of a heavy black paper composition.
3. Replace the side supply and return air compartment panels.

For <u>side</u> duct applications:

1. Replace the side panels on the supply and return air compartments with the accessory flange kit panels.
2. Connect ductwork to the flanges on those panels.

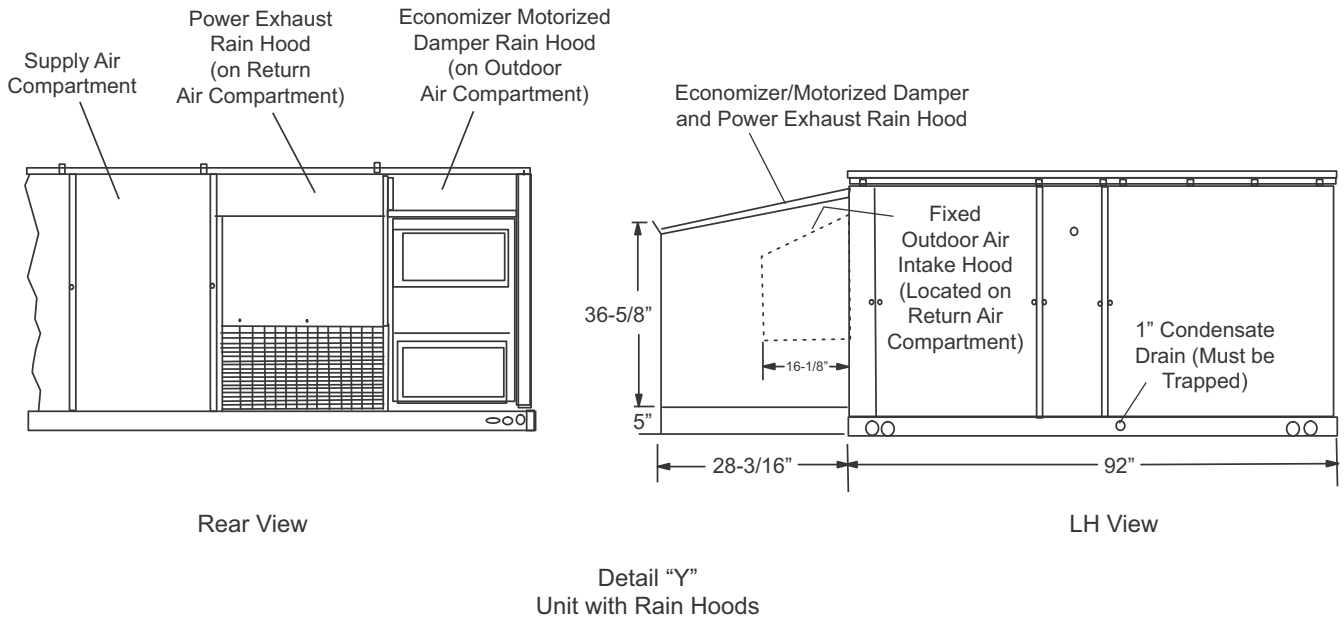


Figure 7: J15 thru 25 ZJ Unit Dimensions Rain Hood

Table 6: J15 thru 25 ZJ Unit Clearances

Direction	Distance (in.)	Direction	Distance (in.)
Top[1]	72 With 36 Maximum Horizontal Overhang (For Condenser Air Discharge)	Right	36
Front	36	Bottom[2]	0
Rear	24 (W/O Economizer)	Left	24 (W/O Economizer)
	49 (W/Economizer)		36 (W/Economizer)[3]

1. Units must be installed outdoors. Over hanging structure or shrubs should not obscure condenser air discharge outlet.
2. Units may be installed on combustable floors made from wood or class A, B or C roof covering materials.
3. If economizer is factory installed, the unassembled rain hood must be removed from its ride along position in front of the evaporator coil, or in the outdoor air compartment, prior to final installation.

Note: ELEC/ELEC Models: Units and ductwork are approved for zero clearance to combustible material when equipped with electric heaters.

GAS/ELEC Models: A 1" clearance must be provided between any combustible material and the supply air ductwork for a distance of 3 feet from the unit.

The products of combustion must not be allowed to accumulate within a confined space and recirculate.

Locate unit so that the vent air outlet hood is at least:

- Three (3) feet above any force air inlet located within 10 horizontal feet (excluding those integral to the unit).
- Four (4) feet below, four horizontal feet from, or one foot above any door or gravity air inlet into the building.
- Four (4) feet from electric and gas meters, regulators and relief equipment.

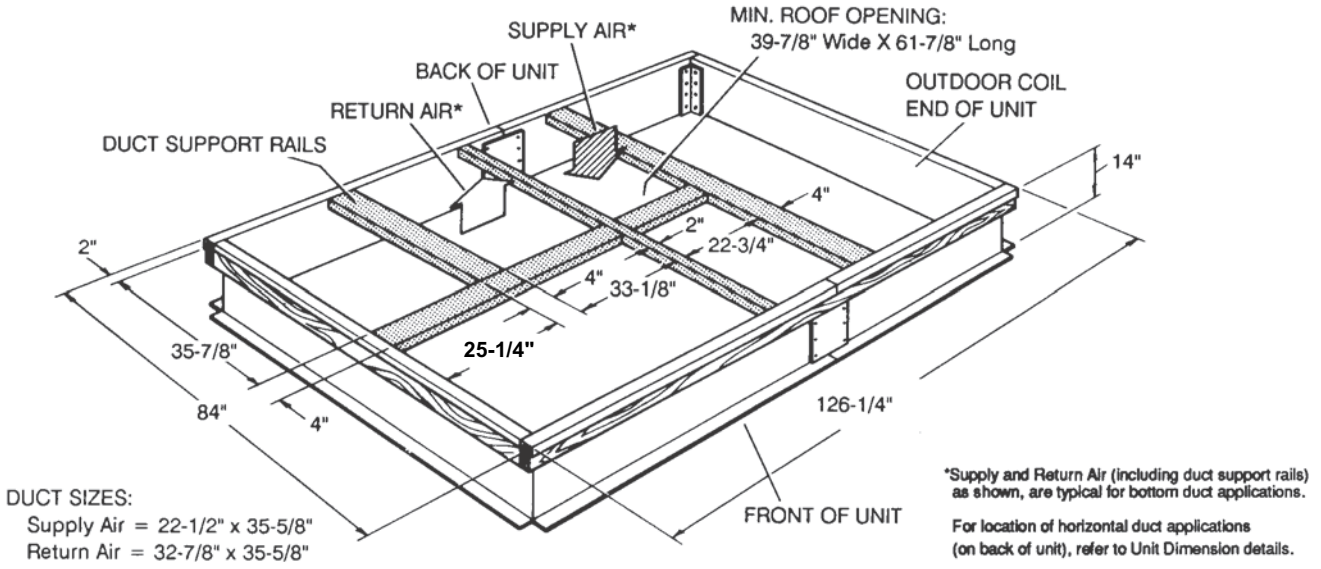


Figure 8: J15 thru 25 ZJ Roof Curb

Ductwork

Ductwork should be designed and sized according to the methods in Manual D of the Air Conditioning Contractors of America (ACCA) or as recommended by any other recognized authority such as ASHRAE or SMACNA.

A closed return duct system should be used. This will not preclude use of economizers or outdoor fresh air intake. The supply and return air duct connections at the unit should be made with flexible joints to minimize noise.

The supply and return air duct systems should be designed for the CFM and static pressure requirements of the job. They should NOT be sized to match the dimensions of the duct connections on the unit.

Refer to Figure 5 for bottom air duct openings. Refer to Figure 6 for side air duct openings.

NOTE: It is recommended that, in Canada, the outlet duct be provided with a removable access panel. It is recommended that this opening be accessible when the unit is installed in service, and of a size such that smoke or reflected light may be observed inside the casing to indicate the presence of leaks in the heat exchanger. The cover should be attached in a manner adequate to prevent leakage.

Fixed Outdoor Air Intake Damper

This damper is shipped inside the return air compartment. It is completely assembled and ready for installation. A damper baffle inside of the hood is adjustable to provide variable amounts of outdoor air intake on units that are not provided with an economizer or a motorized damper option. Refer to the Fixed Outdoor Damper Figure 9.

Gasketing and mounting screws are provided in a parts bag attached to the hood assembly. Apply gasketing to the three flange surfaces on the hood prior to installing the hood. Extend gasketing 1/4 inch beyond the top and bottom of the two side flanges to insure adequate sealing.

Adjusting the damper to the desired air flow may be done before mounting the hood into position or after installation by removing the front hood panel or the screen on the bottom of the hood. Damper baffle in position 1 will allow approximately 10% outdoor air flow, position 2 approximately 15% and, to allow approximately 25%, remove the damper baffle.

On units with bottom return air application install the damper assembly over the opening in the side return air access panel. Remove and discard the opening cover and the covering over the hood mounting holes (used for shipping) before installing. Secure with the screws provided.

On units with side return air applications, install the damper assembly on the return air ductwork as close to the unit as possible. Cut an opening 16 inches high by 18 inches wide in the ductwork to accommodate the damper. Using the holes in the hood flanges as a template, drill 9/64 inch diameter (#26 drill) holes into the ductwork and secure with the screws provided.

⚠ CAUTION

If outdoor air intake will not be required on units with bottom return air applications, the damper assembly should still be mounted on the side return air access panel, per the instructions above, to insure moisture is not drawn into the unit during operation. The covering over the mounting holes only need be removed. Do not remove the opening cover.

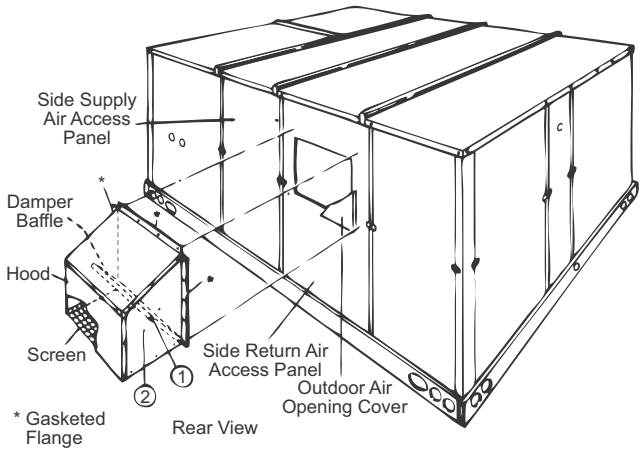


Figure 9: Fixed Outdoor Air Damper

Condensate Drain

Plumbing must conform to local codes. Use a sealing compound on male pipe threads. Install a condensate drain line from the one-inch NPT female connection on the unit to an open drain.

NOTE: The condensate drain operates in a negative pressure in the cabinet. The condensate drain line MUST be trapped to provide proper drainage. See Figure 10.

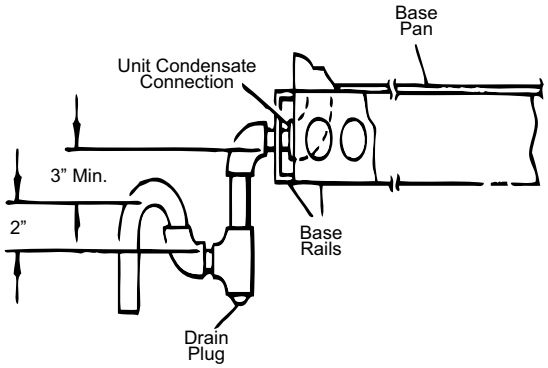


Figure 10: Condensate Drain

Compressors

The scroll compressor used in this product is specifically designed to operate with R-410A Refrigerant and cannot be interchanged.

⚠ CAUTION

This system uses R-410A Refrigerant which operates at higher pressures than R-22. No other refrigerant may be used in this system.

The compressor also uses a polyolester (POE oil), Mobil 3MA POE. This oil is extremely hygroscopic, meaning it absorbs water readily. POE oil can absorb 15 times as much water as other oils designed for HCFC and CFC refrigerants. Take all necessary precautions to avoid exposure of the oil to the atmosphere.

⚠ CAUTION

Do not leave the system open to the atmosphere. Unit damage could occur due to moisture being absorbed by the **POE oil** in the system. This type of oil is highly susceptible to moisture absorption

POE (polyolester) compressor lubricants are known to cause long term damage to some synthetic roofing materials.

⚠ CAUTION

Exposure, even if immediately cleaned up, may cause embrittlement (leading to cracking) to occur in one year or more. When performing any service that may risk exposure of compressor oil to the roof, take precautions to protect roofing.

Procedures which risk oil leakage include, but are not limited to, compressor replacement, repairing refrigerant leaks, replacing refrigerant components such as filter drier, pressure switch, metering device or coil.

Units are shipped with compressor mountings which are factory-adjusted and ready for operation.

⚠ CAUTION

Do not loosen compressor mounting bolts.

Filters

Two-inch filters are supplied with each unit, but units can be converted easily to four-inch filters. Filters must always be installed ahead of the evaporator coil and must be kept clean or replaced with same size and type. Dirty filters will reduce the capacity of the unit and will result in frosted coils or safety shutdown. Minimum filter area and required sizes are shown in Physical Data Table 9.

⚠ CAUTION

Make sure that panel latches are properly positioned on the unit to maintain an airtight seal.

Power And Control Wiring

Field wiring to the unit, fuses, and disconnects must conform to provisions of National Electrical Code (NEC), ANSI/NFPA No. 70 – Latest Edition (in U.S.A.), current Canadian Electrical Code C221, and/or local ordinances. The unit must be electrically grounded in accordance with NEC and CEC as specified above and/or local codes.

⚠ CAUTION

208/230-3-60 and 380/415-3-50 units control transformers are factory wired for 230v and 415v power supply respectively. Change tap on transformer for 208-3-60 or 380-3-50 operation. See unit wiring diagram.

Voltage tolerances which must be maintained at the compressor terminals during starting and running conditions are indicated on the unit Rating Plate and Table 1.

The internal wiring harnesses furnished with this unit are an integral part of the design certified unit. Field alteration to comply with electrical codes should not be required. If any of the wire supplied with the unit must be replaced, replacement wire must be of the type shown on the wiring diagram and the same minimum gauge as the replaced wire.

A disconnect must be utilized for these units. Factory installed disconnects are available. If installing a disconnect (field supplied or Unitary Products supplied accessory), refer to Figure 1 for the recommended mounting location.

⚠ CAUTION

Avoid damage to internal components if drilling holes for disconnect mounting.

NOTE: Since not all local codes allow the mounting of a disconnect on the unit, please confirm compliance with local code before mounting a disconnect on the unit.

Electrical line must be sized properly to carry the load. USE COPPER CONDUCTORS ONLY. Each unit must be wired with a separate branch circuit fed directly from the meter panel and properly fused.

Refer to Figures 11 and 12 for typical field wiring and to the appropriate unit wiring diagram mounted inside control doors for control circuit and power wiring information.

⚠ CAUTION

When connecting electrical power and control wiring to the unit, water-proof connectors must be used so that water or moisture cannot be drawn into the unit during normal operation. The above water-proofing conditions will also apply when installing a field supplied disconnect switch.

Power Wiring Detail

Units are factory wired for the voltage shown on the unit nameplate. Refer to Electrical Data Table 8 to size power wiring, fuses, and disconnect switch.

Power wiring is brought into the unit through the side of the unit or the basepan inside the curb.

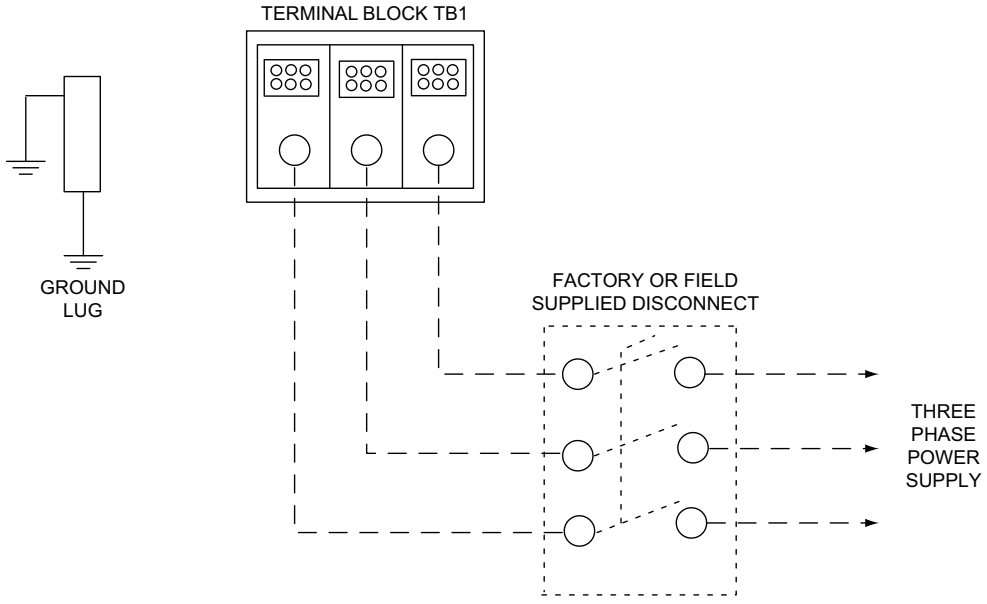


Figure 11: Field Wiring Disconnect - Cooling Unit With/Without Electric Heat

Thermostat Wiring

The thermostat should be located on an inside wall approximately 56 inch above the floor where it will not be subject to drafts, sun exposure or heat from electrical fixtures or appliances. Follow the manufacturer's instructions enclosed with thermostat for general installation procedure. Seven (7) color-coded, insulated wires should be used to connect the thermostat to the unit. Refer to Table 7 for control wire sizing and maximum length.

Space Sensor

The space sensor, if used, should be located on an inside wall approximately 56 inches above the floor where it will not be subject to drafts, sun exposure or heat from electrical fixtures or appliances. Follow manufacturer's instructions enclosed with sensor for general installation procedure.

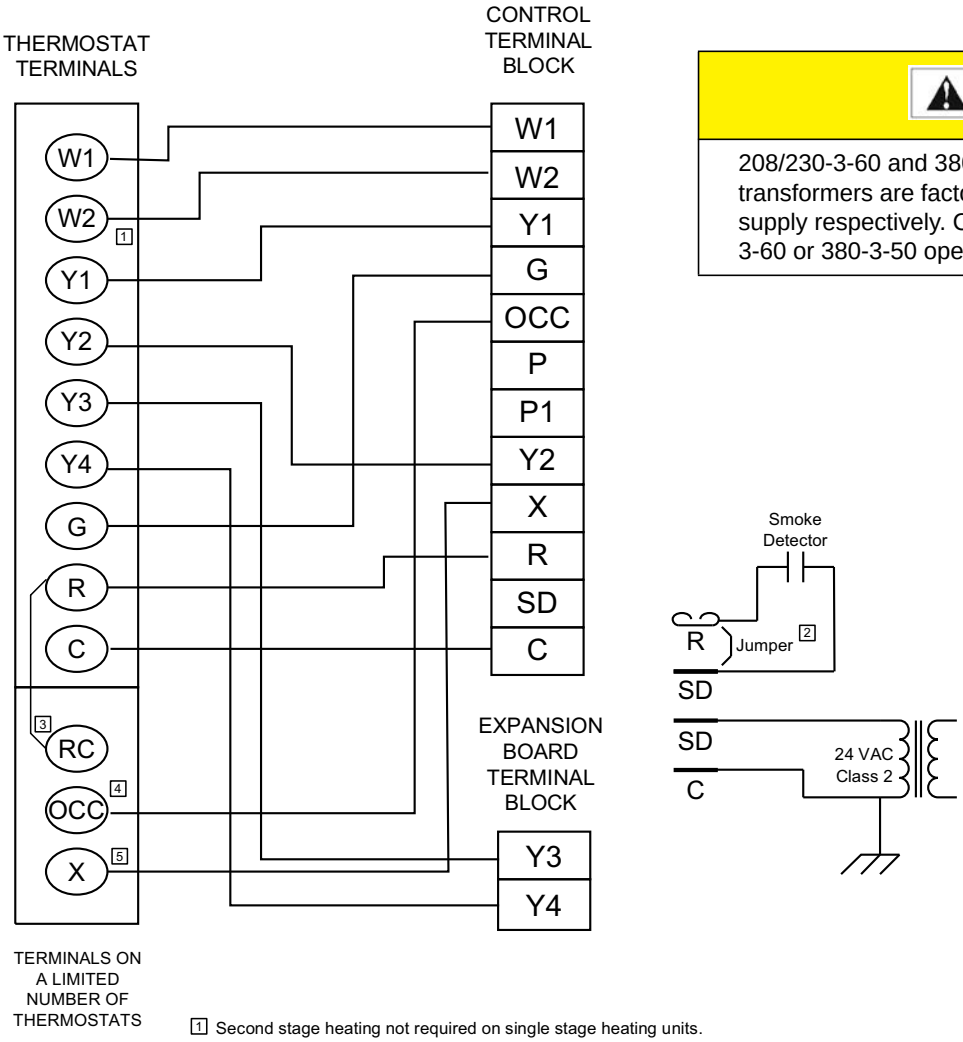
Table 7: Control Wire Sizes

Wire Size	Maximum Length[1]
18 AWG	150 Feet

1. From the unit to the thermostat and back to the unit.

⚠ CAUTION

208/230-3-60 and 380/415-3-50 units control transformers are factory wired for 230v and 415v power supply respectively. Change tap on transformer for 208-3-60 or 380-3-50 operation. See unit wiring diagram.



1 Second stage heating not required on single stage heating units.

2 Jumper is required if there is no Smoke Detector circuit.

3 Jumper is required for any combination of R, RC, or RH.

4 OCC is an output from the thermostat to indicate the Occupied condition.

5 X is an input to the thermostat to display Error Status conditions.

Figure 12: Typical Field Wiring 24 Volt Thermostat

Table 8: Electrical Data

J15 thru 25 ZJ - Standard Drive Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
J15 (15)	208-3-60	13.1	83	20.5	2.1	15.4	0.0	None	--	--	--	80.1	90
								E18	13.5	1	37.5	80.1	90
								E36	27	2	74.9	112.9	125
								E54	40.6	2	112.7	160.1	175
								E72	54.1	2	150.2	169.4	200
	230-3-60	13.1	83	20.5	2.1	14.4	0.0	None	--	--	--	78.8	90
								E18	18.0	1	43.3	78.8	90
								E36	36.0	2	86.6	126.3	150
								E54	54.0	2	129.9	147.9	175
								E72	72.0	2	173.2	191.2	225
	460-3-60	6.1	41	9.5	1.1	7.2	0.0	None	--	--	--	37.8	45
								E18	18.0	1	21.7	37.8	45
								E36	36.0	2	43.3	63.1	70
								E54	54.0	2	65.0	74.0	90
								E72	72.0	2	86.6	95.6	110
	575-3-60	4.4	33	6.8	0.9	5.9	0.0	None	--	--	--	28.6	30
								E18	18.0	1	17.3	29.0	30
								E36	36.0	2	34.6	50.7	60
								E54	54.0	2	52.0	59.3	70
								E72	72.0	2	69.3	76.7	90
J18 (17.5)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
J20 (20)	208-3-60	17.9	120	28.0	3.7	15.4	0.0	None	-	-	-	106.3	110
								E18	13.5	1	37.5	106.3	110
								E36	27.0	2	74.9	112.9	125
								E54	40.6	2	112.7	160.1	175
								E72	54.1	2	150.2	169.4	200
	230-3-60	17.9	120	28.0	3.7	14.4	0.0	None	-	-	-	105.3	110
								E18	18.0	1	43.3	105.3	110
								E36	36.0	2	86.6	126.3	150
								E54	54.0	2	129.9	147.9	175
								E72	72.0	2	173.2	191.2	225
	460-3-60	9.6	70	15.0	1.9	7.2	0.0	None	-	-	-	55.6	60
								E18	18.0	1	21.7	55.6	60
								E36	36.0	2	43.3	63.1	70
								E54	54.0	2	65.0	74.0	90
								E72	72.0	2	86.6	95.6	110
	575-3-60	7.4	53	11.5	1.5	5.9	0.0	None	-	-	-	43.4	50
								E18	18.0	1	17.3	43.4	50
								E36	36.0	2	34.6	50.7	60
								E54	54.0	2	52.0	59.3	70
								E72	72.0	2	69.3	76.7	90

J15 thru 25 ZJ - Standard Drive Without Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
J25 (25)	208-3-60	22.4	149	35.0	3.7	28.0	0.0	None	--	--	--	139.4	150
								E18	13.5	1	37.5	139.4	150
								E36	27.0	2	74.9	139.4	150
								E54	40.6	2	112.7	175.9	200
								E72	54.1	2	150.2	185.2	200
	230-3-60	22.4	149	35.0	3.7	26.0	0.0	None	--	--	--	136.9	150
								E18	18.0	1	43.3	136.9	150
								E36	36.0	2	86.6	140.8	150
								E54	54.0	2	129.9	162.4	175
								E72	72.0	2	173.2	205.7	225
	460-3-60	10.6	75	16.5	1.9	13.0	0.0	None	--	--	--	66.3	70
								E18	18.0	1	21.7	66.3	70
								E36	36.0	2	43.3	70.4	80
								E54	54.0	2	65.0	81.2	90
								E72	72.0	2	86.6	102.9	110
	575-3-60	7.7	54	12.0	1.5	10.3	0.0	None	--	--	--	49.7	50
								E18	18.0	1	17.3	49.7	50
								E36	36.0	2	34.6	56.2	60
								E54	54.0	2	52.0	64.8	70
								E72	72.0	2	69.3	82.2	90

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

J15 thru 25 ZJ - Standard Drive With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
J15 (15)	208-3-60	13.1	83	20.5	2.1	15.4	10.0	None	--	--	--	90.1	100
								E18	13.5	1	37.5	90.1	100
								E36	27	2	74.9	125.4	150
								E54	40.6	2	112.7	172.6	175
								E72	54.1	2	150.2	181.9	200
	230-3-60	13.1	83	20.5	2.1	14.4	10.0	None	--	--	--	88.8	100
								E18	18.0	1	43.3	88.8	100
								E36	36.0	2	86.6	138.8	150
								E54	54.0	2	129.9	160.4	175
								E72	72.0	2	173.2	203.7	225
	460-3-60	6.1	41	9.5	1.1	7.2	5.0	None	--	--	--	42.8	50
								E18	18.0	1	21.7	42.8	50
								E36	36.0	2	43.3	69.4	70
								E54	54.0	2	65.0	80.2	90
								E72	72.0	2	86.6	101.9	110
	575-3-60	4.4	33	6.8	0.9	5.9	4.0	None	--	--	--	32.6	35
								E18	18.0	1	17.3	34.0	35
								E36	36.0	2	34.6	55.7	60
								E54	54.0	2	52.0	64.3	70
								E72	72.0	2	69.3	81.7	90
J18 (17.5)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
J20 (20)	208-3-60	17.9	120	28.0	3.7	15.4	10.0	None	-	-	-	116.3	125
								E18	13.5	1	37.5	116.3	125
								E36	27.0	2	74.9	125.4	150
								E54	40.6	2	112.7	172.6	175
								E72	54.1	2	150.2	181.9	200
	230-3-60	17.9	120	28.0	3.7	14.4	10.0	None	-	-	-	115.3	125
								E18	18.0	1	43.3	115.3	125
								E36	36.0	2	86.6	138.8	150
								E54	54.0	2	129.9	160.4	175
								E72	72.0	2	173.2	203.7	225
	460-3-60	9.6	70	15.0	1.9	7.2	5.0	None	-	-	-	60.6	70
								E18	18.0	1	21.7	60.6	70
								E36	36.0	2	43.3	69.4	70
								E54	54.0	2	65.0	80.2	90
								E72	72.0	2	86.6	101.9	110
	575-3-60	7.4	53	11.5	1.5	5.9	4.0	None	-	-	-	47.4	50
								E18	18.0	1	17.3	47.4	50
								E36	36.0	2	34.6	55.7	60
								E54	54.0	2	52.0	64.3	70
								E72	72.0	2	69.3	81.7	90

J15 thru 25 ZJ - Standard Drive With Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
J25 (25)	208-3-60	22.4	149	35.0	3.7	28.0	10.0	None	--	--	--	149.4	175
								E18	13.5	1	37.5	149.4	175
								E36	27.0	2	74.9	149.4	175
								E54	40.6	2	112.7	188.4	200
								E72	54.1	2	150.2	197.7	200
	230-3-60	22.4	149	35.0	3.7	26.0	10.0	None	--	--	--	146.9	150
								E18	18.0	1	43.3	146.9	150
								E36	36.0	2	86.6	153.3	175
								E54	54.0	2	129.9	174.9	175
								E72	72.0	2	173.2	218.2	225
	460-3-60	10.6	75	16.5	1.9	13.0	5.0	None	--	--	--	71.3	80
								E18	18.0	1	21.7	71.3	80
								E36	36.0	2	43.3	76.6	80
								E54	54.0	2	65.0	87.5	90
								E72	72.0	2	86.6	109.1	110
	575-3-60	7.7	54	12.0	1.5	10.3	4.0	None	--	--	--	53.7	60
								E18	18.0	1	17.3	53.7	60
								E36	36.0	2	34.6	61.2	70
								E54	54.0	2	52.0	69.8	70
								E72	72.0	2	69.3	87.2	90

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

J15 thru 25 ZJ - High Static Drive Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
J15 (15)	208-3-60	13.1	83	20.5	2.1	15.4	0.0	None	--	--	--	80.1	90
								E18	13.5	1	37.5	80.1	90
								E36	27	2	74.9	112.9	125
								E54	40.6	2	112.7	160.1	175
								E72	54.1	2	150.2	169.4	200
	230-3-60	13.1	83	20.5	2.1	14.4	0.0	None	--	--	--	78.8	90
								E18	18.0	1	43.3	78.8	90
								E36	36.0	2	86.6	126.3	150
								E54	54.0	2	129.9	147.9	175
								E72	72.0	2	173.2	191.2	225
	460-3-60	6.1	41	9.5	1.1	7.2	0.0	None	--	--	--	37.8	45
								E18	18.0	1	21.7	37.8	45
								E36	36.0	2	43.3	63.1	70
								E54	54.0	2	65.0	74.0	90
								E72	72.0	2	86.6	95.6	110
	575-3-60	4.4	33	6.8	0.9	5.9	0.0	None	--	--	--	28.6	30
								E18	18.0	1	17.3	29.0	30
								E36	36.0	2	34.6	50.7	60
								E54	54.0	2	52.0	59.3	70
								E72	72.0	2	69.3	76.7	90
J18 (17.5)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
J20 (20)	208-3-60	17.9	120	28.0	3.7	20.0	0.0	None	-	-	-	111.4	125
								E18	13.5	1	37.5	111.4	125
								E36	27.0	2	74.9	118.7	125
								E54	40.6	2	112.7	165.9	175
								E72	54.1	2	150.2	175.2	200
	230-3-60	17.9	120	28.0	3.7	20.0	0.0	None	-	-	-	111.4	125
								E18	18.0	1	43.3	111.4	125
								E36	36.0	2	86.6	133.3	150
								E54	54.0	2	129.9	154.9	175
								E72	72.0	2	173.2	198.2	225
	460-3-60	9.6	70	15.0	1.9	10.0	0.0	None	-	-	-	58.5	60
								E18	18.0	1	21.7	58.5	60
								E36	36.0	2	43.3	66.6	70
								E54	54.0	2	65.0	77.5	90
								E72	72.0	2	86.6	99.1	110
	575-3-60	7.4	53	11.5	1.5	8.2	0.0	None	-	-	-	45.9	50
								E18	18.0	1	17.3	45.9	50
								E36	36.0	2	34.6	53.6	60
								E54	54.0	2	52.0	62.2	70
								E72	72.0	2	69.3	79.5	90

J15 thru 25 ZJ - High Static Drive Without Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
J25 (25)	208-3-60	22.4	149	35.0	3.7	38.6	0.0	None	--	--	--	152.7	175
								E18	13.5	1	37.5	152.7	175
								E36	27.0	2	74.9	152.7	175
								E54	40.6	2	112.7	189.1	200
								E72	54.1	2	150.2	198.4	225
	230-3-60	22.4	149	35.0	3.7	38.6	0.0	None	--	--	--	152.7	175
								E18	18.0	1	43.3	152.7	175
								E36	36.0	2	86.6	156.5	175
								E54	54.0	2	129.9	178.2	200
								E72	72.0	2	173.2	221.5	250
	460-3-60	10.6	75	16.5	1.9	19.3	0.0	None	--	--	--	74.1	90
								E18	18.0	1	21.7	74.1	90
								E36	36.0	2	43.3	78.3	90
								E54	54.0	2	65.0	89.1	100
								E72	72.0	2	86.6	110.7	125
	575-3-60	7.7	54	12.0	1.5	15.4	0.0	None	--	--	--	56.1	70
								E18	18.0	1	17.3	56.1	70
								E36	36.0	2	34.6	62.6	70
								E54	54.0	2	52.0	71.2	80
								E72	72.0	2	69.3	88.5	100

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

J15 thru 25 ZJ - High Static Drive With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
J15 (15)	208-3-60	13.1	83	20.5	2.1	15.4	10.0	None	--	--	--	90.1	100
								E18	13.5	1	37.5	90.1	100
								E36	27	2	74.9	125.4	150
								E54	40.6	2	112.7	172.6	175
								E72	54.1	2	150.2	181.9	200
	230-3-60	13.1	83	20.5	2.1	14.4	10.0	None	--	--	--	88.8	100
								E18	18.0	1	43.3	88.8	100
								E36	36.0	2	86.6	138.8	150
								E54	54.0	2	129.9	160.4	175
								E72	72.0	2	173.2	203.7	225
	460-3-60	6.1	41	9.5	1.1	7.2	5.0	None	--	--	--	42.8	50
								E18	18.0	1	21.7	42.8	50
								E36	36.0	2	43.3	69.4	70
								E54	54.0	2	65.0	80.2	90
								E72	72.0	2	86.6	101.9	110
	575-3-60	4.4	33	6.8	0.9	5.9	4.0	None	--	--	--	32.6	35
								E18	18.0	1	17.3	34.0	35
								E36	36.0	2	34.6	55.7	60
								E54	54.0	2	52.0	64.3	70
								E72	72.0	2	69.3	81.7	90
J18 (17.5)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
								TBD	TBD	TBD	TBD	TBD	TBD
J20 (20)	208-3-60	17.9	120	28.0	3.7	20.0	10.0	None	-	-	-	121.4	125
								E18	13.5	1	37.5	121.4	125
								E36	27.0	2	74.9	131.2	150
								E54	40.6	2	112.7	178.4	200
								E72	54.1	2	150.2	187.7	200
	230-3-60	17.9	120	28.0	3.7	20.0	10.0	None	-	-	-	121.4	125
								E18	18.0	1	43.3	121.4	125
								E36	36.0	2	86.6	145.8	150
								E54	54.0	2	129.9	167.4	175
								E72	72.0	2	173.2	210.7	225
	460-3-60	9.6	70	15.0	1.9	10.0	5.0	None	-	-	-	63.5	70
								E18	18.0	1	21.7	63.5	70
								E36	36.0	2	43.3	72.9	80
								E54	54.0	2	65.0	83.7	90
								E72	72.0	2	86.6	105.4	110
	575-3-60	7.4	53	11.5	1.5	8.2	4.0	None	-	-	-	49.9	50
								E18	18.0	1	17.3	49.9	50
								E36	36.0	2	34.6	58.6	60
								E54	54.0	2	52.0	67.2	70
								E72	72.0	2	69.3	84.5	90

J15 thru 25 ZJ - High Static Drive With Powered Convenience Outlet (Continued)

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
J25 (25)	208-3-60	22.4	149	35.0	3.7	38.6	10.0	None	--	--	--	162.7	200
								E18	13.5	1	37.5	162.7	200
								E36	27.0	2	74.9	162.7	200
								E54	40.6	2	112.7	201.6	225
								E72	54.1	2	150.2	210.9	225
	230-3-60	22.4	149	35.0	3.7	38.6	10.0	None	--	--	--	162.7	200
								E18	18.0	1	43.3	162.7	200
								E36	36.0	2	86.6	169.0	200
								E54	54.0	2	129.9	190.7	225
								E72	72.0	2	173.2	234.0	250
	460-3-60	10.6	75	16.5	1.9	19.3	5.0	None	--	--	--	79.1	90
								E18	18.0	1	21.7	79.1	90
								E36	36.0	2	43.3	84.5	90
								E54	54.0	2	65.0	95.3	110
								E72	72.0	2	86.6	117.0	125
	575-3-60	7.7	54	12.0	1.5	15.4	4.0	None	--	--	--	60.1	70
								E18	18.0	1	17.3	60.1	70
								E36	36.0	2	34.6	67.6	70
								E54	54.0	2	52.0	76.2	90
								E72	72.0	2	69.3	93.5	100

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

J25ZJ - Low Static Drive Without Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
J25 (25)	208-3-60	22.4	149	35.0	3.7	20.0	0.0	None	--	--	--	130.0	150
								E18	13.5	1	37.5	130.0	150
								E36	27.0	2	74.9	130.0	150
								E54	40.6	2	112.7	165.9	175
								E72	54.1	2	150.2	175.2	200
	230-3-60	22.4	149	35.0	3.7	20.0	0.0	None	--	--	--	130.0	150
								E18	18.0	1	43.3	130.0	150
								E36	36.0	2	86.6	133.3	150
								E54	54.0	2	129.9	154.9	175
								E72	72.0	2	173.2	198.2	225
	460-3-60	10.6	75	16.5	1.9	10.0	0.0	None	--	--	--	62.7	70
								E18	18.0	1	21.7	62.7	70
								E36	36.0	2	43.3	66.6	70
								E54	54.0	2	65.0	77.5	90
								E72	72.0	2	86.6	99.1	110
	575-3-60	7.7	54	12.0	1.5	8.2	0.0	None	--	--	--	47.1	50
								E18	18.0	1	17.3	47.1	50
								E36	36.0	2	34.6	53.6	60
								E54	54.0	2	52.0	62.2	70
								E72	72.0	2	69.3	79.5	90

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

J25ZJ - Low Static Drive With Powered Convenience Outlet

Size (Tons)	Volt	Compressors (each)			OD Fan Motors (each)	Supply Blower Motor	Pwr Conv Outlet	Electric Heat Option				MCA[1] (Amps)	Max Fuse[2]/ Breaker[3] Size (Amps)
		RLA	LRA	MCC	FLA	FLA	FLA	Model	kW	Stages	Amps		
J25 (25)	208-3-60	22.4	149	35.0	3.7	20.0	10.0	None	--	--	--	140.0	150
								E18	13.5	1	37.5	140.0	150
								E36	27.0	2	74.9	140.0	150
								E54	40.6	2	112.7	178.4	200
								E72	54.1	2	150.2	187.7	200
	230-3-60	22.4	149	35.0	3.7	20.0	10.0	None	--	--	--	140.0	150
								E18	18.0	1	43.3	140.0	150
								E36	36.0	2	86.6	145.8	150
								E54	54.0	2	129.9	167.4	175
								E72	72.0	2	173.2	210.7	225
	460-3-60	10.6	75	16.5	1.9	10.0	5.0	None	--	--	--	67.7	70
								E18	18.0	1	21.7	67.7	70
								E36	36.0	2	43.3	72.9	80
								E54	54.0	2	65.0	83.7	90
								E72	72.0	2	86.6	105.4	110
	575-3-60	7.7	54	12.0	1.5	8.2	4.0	None	--	--	--	51.1	60
								E18	18.0	1	17.3	51.1	60
								E36	36.0	2	34.6	58.6	60
								E54	54.0	2	52.0	67.2	70
								E72	72.0	2	69.3	84.5	90

1. Minimum Circuit Ampacity.
2. Dual Element, Time Delay Type.
3. HACR type per NEC.

Table 9: J15 thru 25 ZJ Physical Data

Component	Models							
	J15ZJ		J18ZJ		J20ZJ		J25ZJ	
Nominal Tonnage	**15**		**17.5**		**20**		**25**	
AHRI COOLING PERFORMANCE								
Gross Capacity @ AHRI A point (Btu)	181400		TBD		242000		290000	
AHRI net capacity (Btu)	172000		TBD		235000		280000	
EER	12.2		TBD		11.5		10.5	
SEER	-		TBD		-		-	
IEER	12.3		TBD		13.0		10.6	
Nominal CFM	4500		TBD		6200		7000	
System power (KW)	14.10		TBD		20.10		26.67	
Refrigerant type	R-410a		TBD		R-410a		R-410a	
Refrigerant charge (lb-oz)								
System 1	12-0		TBD		12-0		12-4	
System 2	11-12		TBD		12-0		12-8	
System 3	12-4		TBD		12-0		12-8	
System 4	13-8		TBD		12-0		12-8	
AHRI HEATING PERFORMANCE								
Heating model	24	32	TBD	TBD	24	32	24	32
Heat input (K Btu)	300	400	TBD	TBD	300	400	300	400
Heat output (K Btu)	240	320	TBD	TBD	240	320	240	320
AFUE%	-	-	TBD	TBD	-	-	-	-
Steady state efficiency (%)	80	80	TBD	TBD	80	80	80	80
No. burners	6	8	TBD	TBD	6	8	6	8
No. stages	2	2	TBD	TBD	2	2	2	2
Temperature Rise Range (ºF)	20-50	30-60	TBD	TBD	20-50	30-60	20-50	30-60
Gas Limit Setting (ºF)	195	195	TBD	TBD	195	195	195	195
Gas piping connection (in.)	1	1	TBD	TBD	1	1	1	1
DIMENSIONS (inches)								
Length	180-19/32							
Width	92							
Height	52-5/8							
OPERATING WT. (lbs.)	2609		TBD		2697		2783	
COMPRESSORS								
Type	Scroll		TBD		Scroll		Scroll	
Quantity	4		TBD		4		4	
Unit Capacity Steps (%)	25 / 50 / 75 / 100		TBD		25 / 50 / 75 / 100		25 / 50 / 75 / 100	
CONDENSER COIL DATA								
Face area (Sq. Ft.)	63.8		TBD		63.8		63.8	
Rows	2		TBD		2		2	
Fins per inch	20		TBD		20		20	
Tube diameter (in.)	3/8		TBD		3/8		3/8	
Circuitry Type	Split-face		TBD		Split-face		Split-face	
EVAPORATOR COIL DATA								
Face area (Sq. Ft.)	25		TBD		25		25	
Rows	4		TBD		4		4	
Fins per inch	13.5		TBD		13.5		13.5	
Tube diameter	3/8		TBD		3/8		3/8	
Circuitry Type	Split-face		TBD		Split-face		Split-face	
Refrigerant control	TXV		TBD		TXV		TXV	

Table 9: J15 thru 25 ZJ Physical Data (Continued)

Component	Models								
	J15ZJ		J18ZJ		J20ZJ		J25ZJ		
Nominal Tonnage	15		17.5		20		25		
CONDENSER FAN DATA									
Quantity	4		TBD		4		4		
Fan diameter (Inch)	24		TBD		30		30		
Type	Prop		TBD		Prop		Prop		
Drive type	Direct		TBD		Direct		Direct		
No. speeds	1		TBD		1		1		
Number of motors	4		TBD		4		4		
Motor HP each	1/3		TBD		1/3		1/3		
RPM	850		TBD		870		870		
Nominal total CFM	4000		TBD		5000		5000		
BELT DRIVE EVAP FAN DATA									
Quantity	1		TBD		1		1		
Fan Size (Inch)	15 X 15		TBD		18 X 15		18 X 15		
Type	Centrifugal		TBD		Centrifugal		Centrifugal		
Motor Sheave	1VP65	1VP65	TBD	TBD	1VP60	1VP60	1VP60	1VP75X	1VP75X
Blower Sheave	BK110	BK090	TBD	TBD	BK110	BK090	1B5V94	1B5V110	1B5V94
Belt	BX85	BX81	TBD	TBD	BX78	BX75	BX78	5VX840	5VX860
Motor HP each	5	5	TBD	TBD	5	7.5	7.5	10	15
RPM	1725	1725	TBD	TBD	1725	1725	1725	1725	1725
Frame size	184T	184T	TBD	TBD	184T	213T	213T	215T	254T
FILTERS									
Quantity - Size	12 - (12 x 24 x 2)[1,2]		TBD		12 - (12 x 24 x 2)[1,2]		12 - (12 x 24 x 2)[1,2]		
	2 - (20 x 24 x 4), 4 - (24 x 24 x 4)[3]		TBD		2 - (20 x 24 x 4), 4 - (24 x 24 x 4)[3]		2 - (20 x 24 x 4), 4 - (24 x 24 x 4)[3]		

1. 2 In. Throwaway, Standard, MERV (Minimum Efficiency Reporting Value) 3.
2. 2 In. Pleated, Optional, MERV 7.
3. 4 In. Pleated, Optional, MERV 13.

Optional Electric Heat

The factory-installed heaters are wired for single point power supply. Power supply need only be brought into the single point terminal block.

These CSA approved heaters are located within the central compartment of the unit with the heater elements extending in to the supply air chamber.

Fuses are supplied, where required, by the factory. Some kW sizes require fuses and others do not. refer to Table 10 for minimum CFM limitations and to Table 8 for electrical data.

Table 10: Electric Heat Minimum Supply Air

Size (Tons)	Voltage	Minimum Supply Air (CFM)			
		Heater kW			
		9	18	54	72
J15ZJ (15)	208/230-3-60	4500	4500	5000	5000
	460-3-60	4500	4500	5000	4500
	600-3-60	4500	4500	4500	4500
J18ZJ (17.5)	208/230-3-60	6000	6000	6000	6000
	460-3-60	6000	6000	6000	6000
	600-3-60	6000	6000	6000	6000
J20ZJ (20)	208/230-3-60	6000	6000	6000	6000
	460-3-60	6000	6000	6000	6000
	600-3-60	6000	6000	6000	6000
J25ZJ (25)	208/230-3-60	7500	7500	7500	7500
	460-3-60	7500	7500	7500	7500
	600-3-60	7500	7500	7500	7500

Optional Gas Heat

These gas-fired heaters have aluminized-steel or optional stainless steel, tubular heat exchangers with spark ignition with proven pilot.

Table 11: Gas Application Data

Unit		Input (MBH)	Output (MBH)	Temp Rise (°F)[1]
Size	Opt.			
J15ZJ	24	300	240	20-50
	32	400	320	30-60
J18ZJ	24	300	240	20-50
	32	400	320	30-60
J20ZJ	24	300	240	20-50
	32	400	320	30-60
J25ZJ	24	300	240	20-50
	32	400	320	30-60

1. On VAV units, individual VAV boxes must be full open in heating mode to insure airflow falls within temperature rise range.

Gas Piping

Proper sizing of gas piping depends on the cubic feet per hour of gas flow required, specific gravity of the gas and the length of run. “National Fuel Gas Code” Z223.1 (in U.S.A.) or the current Gas Installation Codes CSA-B149.1 (in Canada) should be followed in all cases unless superseded by local codes or gas utility requirements. Refer to the Pipe Sizing Table 12. The heating value of the gas may differ with locality. The value should be checked with the local gas utility.

NOTE: There may be a local gas utility requirement specifying a minimum diameter for gas piping. All units require a one-inch pipe connection at the entrance fitting.

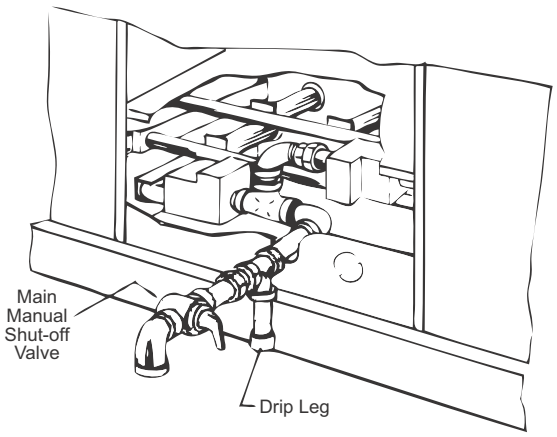


Figure 13: External Supply Connection External Shut-Off

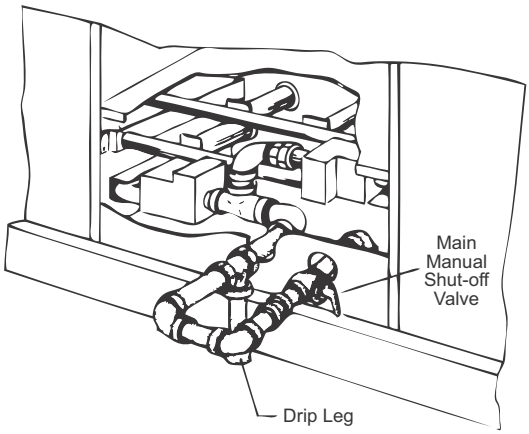


Figure 14: Bottom Supply Connection External Shut-Off

Table 12: Gas Pipe Sizing - Capacity of Pipe

Length of Pipe (ft.)	Nominal Iron Pipe Size	
	1 in.	1-1/4 in.
10	520	1050
20	350	730
30	285	590
40	245	500
50	215	440
60	195	400
70	180	370
80	170	350
90	160	320
100	150	305

NOTE: Maximum capacity of pipe in cubic feet of gas per hour based upon a pressure drop of 0.3 inch W.C. and 0.6 specific gravity gas.

Table 13: Gas Heat Minimum Supply Air

Size (Tons)	Heat Size	Supply Air (CFM)			
		Cooling		Heating	
		Min	Max	Min	Max
J15ZJ	24	4500	7000	4500	7000
(15)	32	4500	7000	4500	7000
J18ZJ	24	6000	8750	6000	8750
(17.5)	32	6000	8750	6000	8750
J20ZJ	24	6000	9400	6000	9400
(20)	32	6000	9400	6000	9400
J25ZJ	24	7500	12500	7500	12500
(25)	32	7500	12500	7500	12500

Gas Connection

The gas supply line can be routed within the space and roof curb, exiting through the unit's basepan. Refer to Figure 5 for the gas piping inlet location. Typical supply piping arrangements are shown in Figures 13 and 14. All pipe nipples, fittings, and the gas cock are field supplied.

Gas piping recommendations:

1. A drip leg and a ground joint union must be installed in the gas piping.
2. Where required by local codes, a manual shut-off valve must be installed outside of the unit.
3. Use wrought iron or steel pipe for all gas lines. Pipe dope should be applied sparingly to male threads only.

⚠WARNING

Natural gas may contain some propane. Propane is an excellent solvent and will quickly dissolve white lead and most standard commercial compounds. A special pipe dope must be used when assembling wrought iron or steel pipe. Shellac based compounds such as Gaskolac or Stalastic, and compounds such as Rectorseal #5, Clydes's or John Crane may be used.

4. All piping should be cleaned of dirt and scale by hammering on the outside of the pipe and blowing out loose particles. Before initial start-up, be sure that all gas lines external to the unit have been purged of air.
5. The gas supply should be a separate line and installed in accordance with all safety codes as prescribed under "Limitations".
6. A 1/8-inch NPT plugged tapping, accessible for test gage connection, must be installed immediately upstream of the gas supply connection to the unit.
7. After the gas connections have been completed, open the main shut-off valve admitting *normal gas pressure* to the mains. *Check all joints for leaks with soap solution or other material suitable for the purpose.* **NEVER USE A FLAME.**

⚠WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow the safety warning exactly could result in serious injury, death or property damage.

Never test for gas leaks with an open flame. use a commercially available soap solution made specifically for the detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury or loss of life.

⚠CAUTION

The furnace and its individual shut-off valve must be disconnected from the gas supply piping system during any pressure testing at pressures in excess of 1/2 PSIG.

Pressures greater than 1/2 PSIG will cause gas valve damage resulting in a hazardous condition. If it is subjected to a pressure greater than 1/2 PSIG, the gas valve must be replaced.

The furnace must be isolated from the gas supply piping system by closing its individual manual shut-off valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 PSIG.

⚠WARNING

Threaded joints should be coated with a sealing compound that is resistant to the action of liquefied petroleum gases. **Do not use Teflon tape.**

Lp Units, Tanks And Piping

All gas heat units are shipped from the factory equipped for natural gas use only. The unit may be converted in the field for use with LP gas with accessory kit model number 1NP0418.

All LP gas equipment must conform to the safety standards of the National Fire Protection Association.

For satisfactory operation, LP gas pressure must be 10.0 inch W.C. at the unit under full load. Maintaining proper gas pressure depends on three main factors:

1. The vaporization rate which depends on the temperature of the liquid and the "wetted surface" area of the container(s).
2. The proper pressure regulation. (Two-stage regulation is recommended).
3. The pressure drop in the lines between regulators and between the second stage regulator and the appliance. Pipe size required will depend on the length of the pipe run and the total load of all appliances.

Complete information regarding tank sizing for vaporization, recommended regulator settings, and pipe sizing is available from most regulator manufacturers and LP gas suppliers.

⚠WARNING

LP gas is an excellent solvent and will quickly dissolve white lead and most standard commercial compounds. A special pipe dope must be used when assembling wrought iron or steel pipe for LP. Shellac base compounds such as Gaskolac or Stalastic, and compounds such as Rectorseal #5, Clyde's, or John Crane may be used.

Check all connections for leaks when piping is completed using a soap solution. **NEVER USE A FLAME.**

⚠WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow the safety warning exactly could result in serious injury, death or property damage.

Never test for gas leaks with an open flame. use a commercially available soap solution made specifically for the detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury or loss of life.

Vent And Combustion Air

Two vent hoods and a combustion air hood (with screens) are shipped attached to the blower housing in the blower compartment. For units with factory installed VFD option, the hoods and accompanying hardware are shipped inside the gas heat section. These hoods must be installed to assure proper unit function. All hoods must be fastened to the outside of the gas heat access panel with the screws provided in the bag also attached to the blower housing.

The screen for the combustion air intake hood is secured to the inside of the access panel opening with four fasteners and the screws used for mounting the hood to the panel. The top flange of this hood slips in under the top of the access panel opening when installing. Refer to Vent and Combustion Air Hood Figure 15.

Each vent hood is installed by inserting the top flange of the hood into the slotted opening in the access panel and securing in place.

The products of combustion are discharged horizontally through these two screened, hooded vent openings on the upper gas heat access panel.

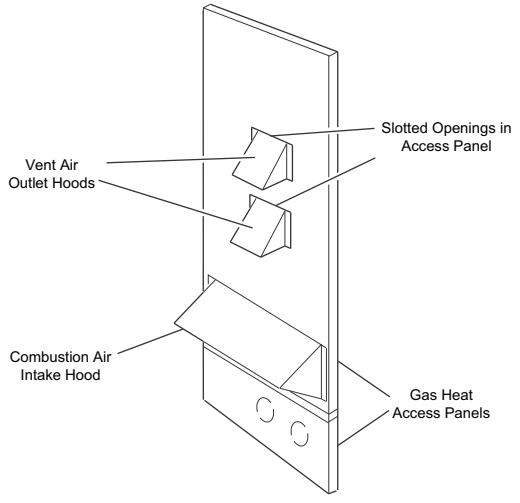


Figure 15: Vent and Combustion Air Hood

Options/Accessories

Electric Heat

Electric heaters are available as a factory-installed option. These heaters mount in the heat compartment with the heating elements extending into the supply air chamber. All electric heaters are fused and intended for use with single point power supply.

Economizer/Motorized Outdoor Damper Rain Hood

The instruction for the optional economizer/motorized damper rain hood can be found in the rain hood kit. Use these instructions when field assembling an economizer rain hood onto a unit. The outdoor and return air dampers, the damper actuator, the damper linkage, the outdoor and return air divider baffles, and all the control sensors are factory mounted as part of the “Factory installed” economizer option.

Power Exhaust/Barometric Relief Damper and Rain Hood

The instructions for the power exhaust/barometric relief damper and rain hood can be found in the rain hood kit. The exhaust fan, all supporting brackets, angles, and the wiring are factory installed as part of the power exhaust option.

Economizer And Power Exhaust Set Point Adjustments

Remove the top rear access panel from the unit. Locate the economizer control module, where the following adjustments will be made.

⚠ CAUTION

Extreme care must be exercised in turning all set point, maximum and minimum damper positioning adjustment screws to prevent twisting them off.

Minimum Position Adjustment

- Check that the damper blades move smoothly without binding; carefully turn the Minimum Position Adjust screw (found on the damper control module) fully clockwise and then set the thermostat indoor fan switch to the ON position and then OFF or energize and de-energize terminals “R” to “G”.
- With the thermostat set to the indoor fan ON position or terminals “R” to “G” energized, turn the Minimum Position Adjusting screw (located on the damper control module) counterclockwise until the desired minimum damper position has been attained.

Enthalpy Set Point Adjustment

- The enthalpy set point may now be set by selecting the desired set point shown in the Enthalpy Set Point Adjustment Figure 16. Adjust as follows:
- For a single enthalpy operation carefully turn the set point adjusting screw (found on the damper control

module) to the “A”, “B”, “C” or “D” setting corresponding to the lettered curve of the Enthalpy Set Point Adjustment Figure 17.

- For a dual enthalpy operation, carefully turn the set point adjusting screw fully clockwise past the "D" setting.

Power Exhaust Damper Set Point

With power exhaust option, each building pressurization requirement will be different. The point at which the power exhaust comes on is determined by the economizer damper position (Percent Open). The Exhaust Air Adjustment Screw should be set at the Percent Open of the economizer damper at which the power exhaust is needed. It can be set from 0 to 100% damper open.

Indoor Air Quality AQ

Indoor Air Quality (indoor sensor input): Terminal AQ accepts a +2 to +10 Vdc signal with respect to the (AQ1) terminal. When the signal is below it's set point, the actuator is allowed to modulate normally in accordance with the enthalpy and mixed air sensor inputs. When the AQ signal exceeds it's set point setting and there is no call for free cooling, the actuator is proportionately modulated from the 2 to 10 Vdc signal, with 2 Vdc corresponding to full closed and 10 Vdc corresponding to full open. When there is no call for free cooling, the damper position is limited by the IAQ Max damper position setting. When the signal exceeds it's set point (Demand Control Ventilation Set Point) setting and there is a call for free cooling, the actuator modulates from the minimum position to the full open position based on the highest call from either the mixed air sensor input or the AQ voltage input.

- Optional CO_2 Space Sensor Kit Part # 2AQ04700324
- Optional CO_2 Sensor Kit Part # 2AQ04700424

Replace the top rear access panel on the unit.

Optional BAS-Ready Economizer Power Exhaust Damper Set Point Adjustment

Remove the economizer access panel from the unit. Loosen, but do not remove the two panel latches. Locate the economizer actuator, where the following adjustment can be made.

With power exhaust option, each building pressurization requirement will be different. The point at which the power exhaust comes on is determined by the economizer's outdoor damper position. The actuator's auxiliary switch adjustment screw should be set at the damper position at which the power exhaust is needed. The adjustment screw can be set between 25 to 85 degrees open.

Replace the economizer access panel.

Optional Variable Air Volume (VAV)

A variable air volume (VAV) option using a variable frequency drive (VFD) is available for applications requiring a constant supply duct static pressure. A differential pressure transducer is used to monitor supply duct static pressure and return a speed reference signal to the VFD to control the output of the indoor blower motor.

Duct Static Pressure Transducer

A 0-5" WC pressure transducer, located in the control box compartment, is used to sense static (gauge) pressure in the supply air duct and convert this pressure measurement to a proportional 0-5 VDC electrical output.

Pressure-transmitting plastic tubing (1/4" diameter) must be field supplied and installed from the transducer to both the ductwork and to the atmosphere. Connect the tubing from the 'HIGH' pressure tap of the transducer to a static pressure tap (field supplied) in the supply duct located at a point where constant pressure is expected. To prevent an unstable signal due to air turbulence, there should be no obstructions, turns or VAV terminal boxes up- or down-stream of the sensing tube location for at least a distance of 6-10 times the duct diameter. Tubing must also be run between the 'LOW' pressure tap of the transducer and atmospheric pressure (outside of the unit).

⚠ CAUTION

Do not run plastic tubing in the supply or return air ducts as air movement could cause erroneous pressure measurements. If the tubing penetrates through the bottom of the unit be sure openings are sealed to prevent air and water leakage.

Vav Control Board

A VAV control board, located in the top-left corner of the control box, is used to convert the pressure transducer input signal into a speed reference signal that the drive uses to control the speed of the blower motor. This modulating speed reference signal is generated using an internal algorithm which continuously calculates an output value.

A brief description of the VAV board's I/O terminals that are used follows:

Inputs:

- **DUCT PRES** - a 0-5 VDC analog input provided by a factory-installed duct static pressure transducer located in the unit's control box.
- **SAT -** analog input provided by a factory-installed 10k-ohm, type 3 thermistor located in the unit's supply air compartment.
- **RAT -** analog input provided by a factory-installed 10k-ohm, type 3 thermistor located in the unit's return air compartment.
- **OAT -** analog input provided by a factory-installed 10k-ohm, type 3 thermistor located in the outdoor air compartment or mounted within the evaporator base rail for units without the installed economizer option.
- **ST -** analog input provided by field-installed space temperature sensor.

- **OH -** a 0-10 VDC analog input provided by a field-installed outdoor air relative humidity sensor for single enthalpy economizer configuration.
- **RH -** a 0-10 VDC analog input provided by a field-installed return air relative humidity sensor for dual enthalpy economizer configuration (used with OH).
- **IAQ -** a 0-10 VDC analog input provided by a field-installed carbon dioxide sensor which monitors indoor air quality (CO2 concentration) and enables call for Demand Ventilation mode for units installed with economizer option.
- **OAQ -** a 0-10 VDC analog input provided by a field-installed carbon dioxide sensor which monitors outdoor air quality (CO2 concentration) and, along with IAQ, enables call for Differential Demand Ventilation mode for units installed with economizer option.
- **APS -** a 24 VAC binary input provided by a field-installed air proving switch which monitors the pressure difference across the indoor blower.
- **PUR -** a 24 VAC binary input for building purge calls from an external source.
- **OCC -** a 24 VAC binary input used to set the building occupancy status for the control.
- **LIMIT 2 -** a 24 VAC binary input which either confirms 2nd-stage gas heat operation or receives an error signal from the variable frequency drive.

Outputs:

- **FAN -** a 2-10 VDC analog output signal sent to the VFD to modulate the speed of the indoor blower motor.
- **ECON -** a 2-10 VDC analog output signal sent to the economizer actuator to modulate position of the return air and outdoor air dampers (optional).
- **EXH ~ -** a 24 VAC binary output signal used to turn on/off the power exhaust relay (optional).
- **VAV BOX (gas/electric heat only) -** a normally open relay contact connected to a terminal block, used to drive the building's VAV boxes to full-open during heating operation.

Programmable set points:

The *duct static set point* is the pressure that the drive will maintain when operating the unit in VAV mode. The set-point is adjustable between 0" WC and 5" WC with the default setting of 1.5" WC.

The *duct static high-limit set point* is the maximum allowable duct pressure to prevent damage from over-pressurization of the ductwork in the event of either a drive or damper failure. The high-limit set-point is adjustable between 0" WC and 5" WC with the factory default setting of 4.5" WC. If the duct static pressure reaches the high-limit set point, then the supply fan motor will be shutdown.

NOTE: Either of the set points described above can be changed through the unit control board (UCB) with the use of a USB-to-RS485 converter, personal computer or PDA and a down-loaded copy of the Simplicity® software available at the UPGnet Commercial Product Catalog website.

⚠ CAUTION

The customer must be aware of the duct pressure design limit, and what the duct pressure sensor is reading when the peak pressure is reached (i.e. the pressure transducer sensing tube may not be located at the place of highest pressure in the system).

Factory-installed VFD

The factory-installed VFD is mounted in the Blower Access Compartment above the blower assembly. The drive comes wired from the factory to include both 3-phase power and control connections (run permit signal, speed reference signal & fault signal).

All required drive parameters are pre-programmed at the factory, except in the case of 208-volt applications, in which the parameter that defines motor nameplate voltage must be changed to a value of 208.00 and the parameter that defines motor-rated current must be changed to the appropriate value appearing on the motor's nameplate. Refer to the enclosed drive material or access the UPGnet Commercial Product Catalog website for instructions on changing parameter settings.

For units also equipped with gas/electric heat, a terminal block located in the unit's control box and connected to the VAV board's "VAV BOX" terminal, must be field wired to the building's VAV boxes to ensure fully open dampers during heating operation.

Manual Bypass

An optional, factory-installed manual bypass switch available with factory-installed VFD can be found in the Blower Motor Access compartment and has the following three positions:

- **DRIVE** - routes power through the VFD for modulating control of the indoor blower motor.
- **LINE** (or BYPASS) - routes power directly to the motor which provides full-speed motor operation and complete electrical isolation of the drive.
- **TEST** - routes power to the VFD but not to the motor to allow for drive programming and/or diagnostics.

If a drive failure occurs, the unit does not automatically switch to bypass mode. The LINE/DRIVE/TEST switch must be manually switched to the LINE (BYPASS) position. If there is a call for the fan, the indoor blower motor will run at full-speed while in the bypass mode.

⚠ CAUTION

If the unit is operated with the manual bypass switch in the LINE (BYPASS) position and there are VAV boxes present in the duct system, then boxes must be driven to the full-open position using a customer-supplied power source to prevent over-pressurizing and possible damage to the ductwork.

⚠WARNING

Before beginning any service, disconnect all power to the drive. Be aware that high voltages are present in the drive even after power has been disconnected. Capacitors within the drive must be allowed to discharge before beginning service.

BAS-Ready VFD

Factory-installed VFD is also available with 'BAS-ready' models. Terminal blocks are provided in the control box (in place of the VAV control board) for field wiring of a customer-installed BAS to receive 24 VAC power and to connect to the following control signals:

- a duct static pressure transducer input signal (0-5 VDC)
- an economizer actuator input signal (2-10 VDC)
- an economizer actuator output signal (2-10 VDC)
- a VFD speed reference output signal (2-10 VDC)

The use of shielded cable is recommended for the above control wiring connections.

NOTE: Factory-installed VFD is not available with factory-installed BAS options due to space limitations in the control box.

A solid-state, lock-out relay (LR) and 100-µF, 50 VDC capacitor must be field-supplied and installed to provide a means to transmit a potential fault signal back to the BAS controller. The specific relay part number required will depend upon the need for either AC-output or DC-output. See price pages for further details.

Once the appropriate relay and capacitor are obtained, install the capacitor across LR terminals '3' & '4' and make the following wiring connections:

- LR '1' to BAS controller
- LR '2' to BAS controller
- LR '3' to UCB 'X'
- LR '4' to UCB 'C'

'VFD-Ready' For Customer-installation

Units configured as 'VFD-ready' provide provisions for a customer-installed drive. The physical dimensions of VFDs can vary greatly among manufacturers, horsepower ratings and voltage requirements. Keep in mind that drive manufacturers also require various minimum clearances to allow for adequate internal cooling of the drive during operation.

The unit comes with a mounting bracket installed in the Blower Access compartment which may accommodate other vendor's drives depending on their size. In order to utilize the unit's mounting bracket, the maximum recommended drive dimensions are as follows:

For 5-hp motor applications ..... 13" H x 6" W x 7" D
For 7.5 thru 15-hp motor applications..... 13" H x 8" W x 8" D

If the drive will not fit in the allotted space, then it will need to be mounted elsewhere; either within the building on a perpendicular wall which is not subjected to excessive temperature, vibration, humidity, dust, corrosive gas, explosive gas, etc., or within an appropriate enclosure rated for outside installation to safeguard against moisture, dust and excessive heat.

The power leads to the drive (L1, L2, L3) and from the motor (T1, T2, T3) along with the respective ground wires are supplied with the unit and need to be connected after the drive is installed.

⚠ CAUTION

Do not connect AC power to the T1, T2, T3 drive terminals to prevent damage to the VFD.

A terminal block located in the control box is provided for field connection of the VFD speed reference signal (2-10 VDC) and to the normally-open, run-permit auxiliary contact. The use of shielded cable is recommended for the above control wiring connections.

For VFD-ready units also equipped with gas/electric heat, a terminal block located in the unit's control box and connected to the VAV board's "VAV BOX" terminal, must be field wired to the building's VAV boxes to ensure fully open dampers during heating operation.

Optional Hot Gas Bypass (HGBP)

To allow for low cooling load operation, a direct-acting, pressure-modulating bypass control valve installed on the system #1 discharge line is used to divert high temperature, high pressure refrigerant around the TXV in order to maintain a desired minimum evaporator pressure.

The opening pressure of the bypass valve is fully adjustable between 0 and 80 psig with a factory-setting of 60 psig. HGBP is standard on all units with VAV and optional with CV units.

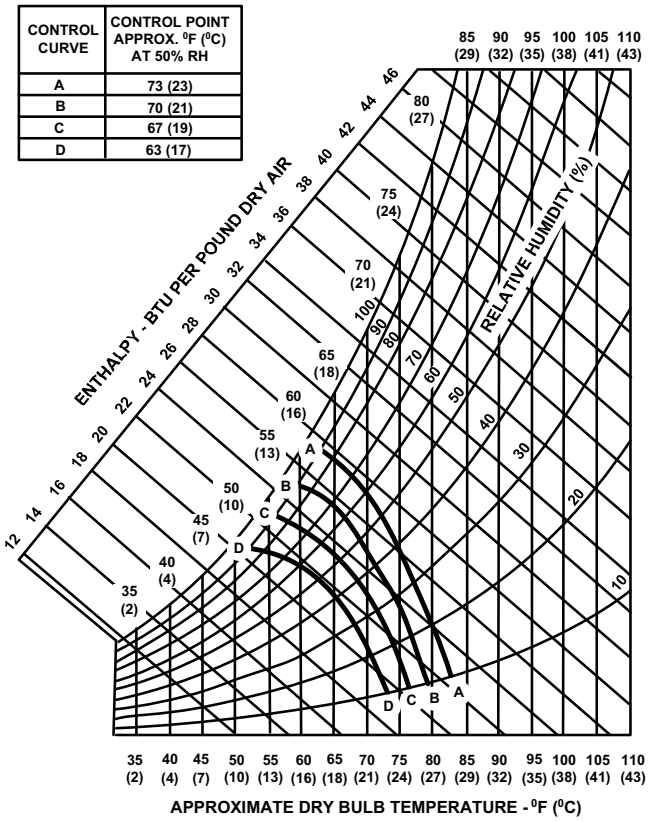

CONTROL CURVE
CONTROL POINT APPROX. °F (°C) AT 50% RH
A 73 (23)
B 70 (21)
C 67 (19)
D 63 (17)
ENTHALPY - BTU PER POUND DRY AIR
RELATIVE HUMIDITY (%)
APPROXIMATE DRY BULB TEMPERATURE - °F (°C)

Figure 16: Enthalpy Set Point Chart

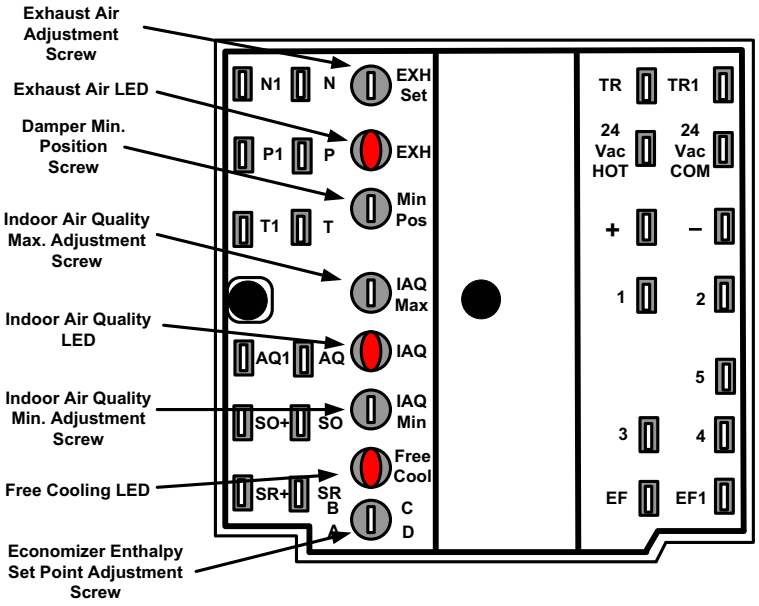


Figure 17: Economizer Control (Excludes VFD and BAS Options)

Phasing

Johnson Controls Model J**ZJ units are properly phased at the factory. Check for proper compressor rotation. If the blower or compressors rotate in the wrong direction at start-up, the electrical connection to the unit is misphased. Change the phasing of the **Field Line Connection at the factory or field supplied disconnect** to obtain proper rotation. (Scroll compressors operate in only one direction. If the scroll is drawing low amperage, has similar suction and discharge pressures, or producing a high noise level, the scroll is misphased.)

⚠ CAUTION

Scroll compressors require proper rotation to operate correctly. Units are properly phased at the factory. Do not change the internal wiring to make the blower condenser fans, or compressor rotate correctly.

Blower Rotation

Check for proper supply air blower rotation. If the blower is rotating backwards, the line voltage at the unit point of power connection is misphased (See 'PHASING').

Belt Tension

The tension on the belt should be adjusted as shown in Figure 18.

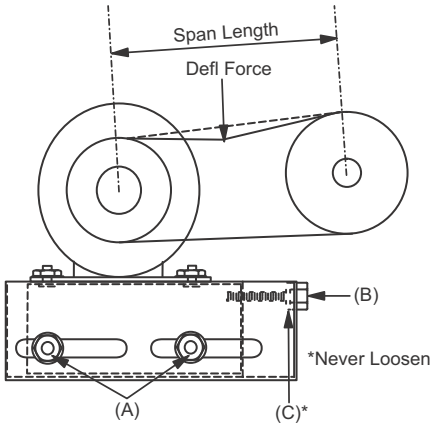


Figure 18: Belt Adjustment

⚠ CAUTION

Procedure for adjusting belt tension:

1. Loosen six nuts (top and bottom) A.
2. Adjust by turning (B).
3. Never loosen nuts (C).
4. Use belt tension checker to apply a perpendicular force to one belt at the midpoint of the span as shown. Deflection distance of 4mm (5/32") is obtained.

To determine the deflection distance from normal position, use a straight edge from sheave to sheave as reference line. The recommended deflection force is as follows:

Tension new belts at the max. deflection force recommended for the belt section. Check the belt tension at least two times during the first 24 hours of operation. Any retensioning should fall between the min. and max. deflection force values.

5. After adjusting retighten nuts (A).

CFM Static Pressure and Power-Altitude and Temperature Corrections

The information below should be used to assist in application of product when being applied at altitudes at or exceeding 1000 feet above sea level.

The air flow rates listed in the standard blower performance tables are based on standard air at sea level. As the altitude or temperature increases, the density of air decreases. In order to use the indoor blower tables for high altitude applications, certain corrections are necessary.

A centrifugal fan is a "constant volume" device. This means that, if the rpm remains constant, the CFM delivered is the same regardless of the density of the air. However, since the air at high altitude is less dense, less static pressure will be generated and less power will be required than a similar application at sea level. Air density correction factors are shown in Table 14 and Figure 19.

Table 14: Altitude/Temperature Correction Factors

Air Temp.	Altitude (Ft.)										
	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
40	1.060	1.022	0.986	0.950	0.916	0.882	0.849	0.818	0.788	0.758	0.729
50	1.039	1.002	0.966	0.931	0.898	0.864	0.832	0.802	0.772	0.743	0.715
60	1.019	0.982	0.948	0.913	0.880	0.848	0.816	0.787	0.757	0.729	0.701
70	1.000	0.964	0.930	0.896	0.864	0.832	0.801	0.772	0.743	0.715	0.688
80	0.982	0.947	0.913	0.880	0.848	0.817	0.787	0.758	0.730	0.702	0.676
90	0.964	0.929	0.897	0.864	0.833	0.802	0.772	0.744	0.716	0.689	0.663
100	0.946	0.912	0.880	0.848	0.817	0.787	0.758	0.730	0.703	0.676	0.651

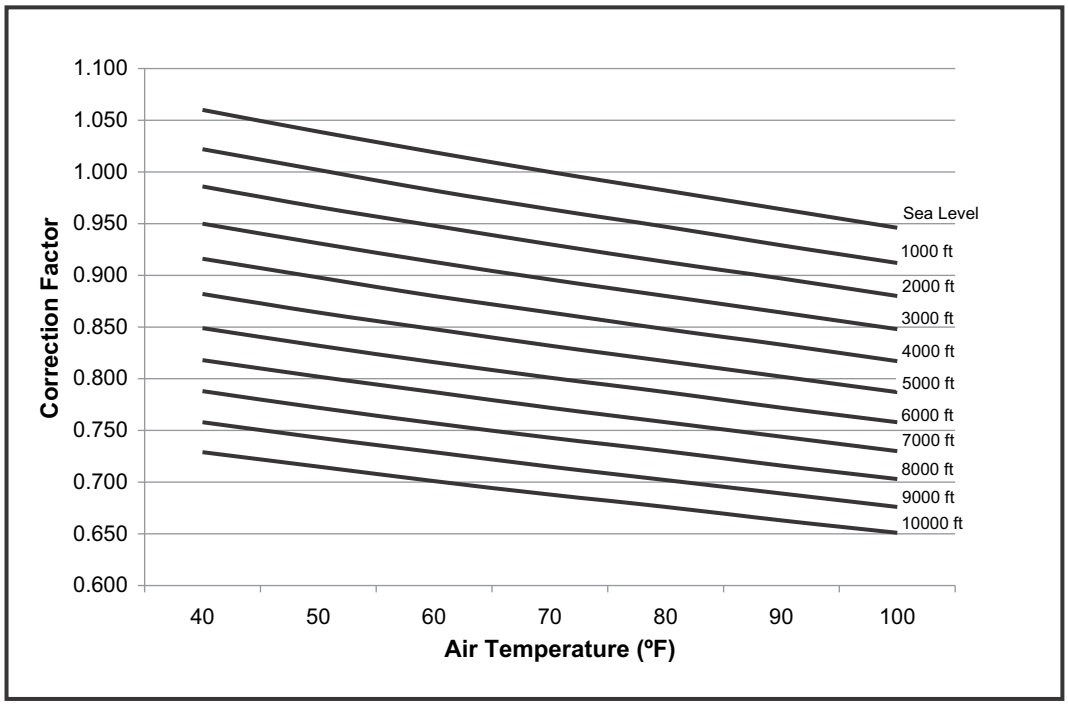


Figure 19: Altitude/Temperature Correction Factors

The examples below will assist in determining the airflow performance of the product at altitude.

Example 1: What are the corrected CFM, static pressure, and BHP at an elevation of 5,000 ft. if the blower performance data is 6,000 CFM, 1.5 IWC and 4.0 BHP?

Solution: At an elevation of 5,000 ft. the indoor blower will still deliver 6,000 CFM if the rpm is unchanged. However, Table 14 must be used to determine the static pressure and BHP. Since no temperature data is given, we will assume an air temperature of 70°F. Table 14 shows the correction factor to be 0.832.

Corrected static pressure = 1.5 x 0.832 = 1.248 IWC

Corrected BHP = 4.0 x 0.832 = 3.328

Example 2: A system, located at 5,000 feet of elevation, is to deliver 6,000 CFM at a static pressure of 1.5". Use the unit blower tables to select the blower speed and the BHP requirement.

Solution: As in the example above, no temperature information is given so 70°F is assumed.

The 1.5" static pressure given is at an elevation of 5,000 ft. The first step is to convert this static pressure to equivalent sea level conditions.

Sea level static pressure = 1.5 / .832 = 1.80"

Enter the blower table at 6000 sCFM and static pressure of 1.8". The rpm listed will be the same rpm needed at 5,000 ft.

Suppose that the corresponding BHP listed in the table is 3.2. This value must be corrected for elevation.

BHP at 5,000 ft. = 3.2 x .832 = 2.66

Drive Selection

1. Determine side or bottom supply duct application.
2. Determine desired airflow
3. Calculate or measure the amount of external static pressure.
4. Using the operating point determined from steps 1, 2 & 3, locate this point on the appropriate supply air blower performance table. (Linear interpolation may be necessary.)
5. Noting the RPM and BHP from step 4, locate the appropriate motor and/or drive on the RPM selection table.
6. Review the BHP compared to the motor options available. Select the appropriate motor and/or drive.
7. Review the RPM range for the motor options available. Select the appropriate drive if multiple drives are available for the chosen motor.
8. Determine turns open to obtain the desired operation point.

Example

1. 6800 CFM
2. 2.0 iwg
3. Using the supply air blower performance table below, the following data point was located: 1020 RPM & 5.92 BHP.
4. Using the RPM selection table below, Size X and Model Y is found.
5. 5.92 BHP exceeds the maximum continuous BHP rating of the 5.0 HP motor. The 7.5 HP motor is required.
6. 1020 RPM is within the range of the 7.5 HP drives.
7. Using the 7.5 HP motor and drive, 3.5 turns open will achieve 1020 RPM.

Example Supply Air Blower Performance

Air Flow (CFM)	Available External Static Pressure - IWG																							
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive		Standard 5 HP & Drive										High Static 7.5 HP & Drive											
6400	719	2.55	756	3.03	792	3.49	828	3.92	864	4.32	899	4.67	933	4.98	966	5.24	998	5.45	1028	5.59	1056	5.67	1083	5.68
6800	742	3.02	778	3.51	814	3.97	850	4.40	886	4.79	921	5.15	955	5.46	988	5.72	1020	5.92	1050	6.07	1078	6.15	1105	6.16
7200	765	3.54	802	4.03	838	4.49	874	4.92	910	5.32	945	5.67	979	5.98	1012	6.24	1044	6.44	1074	6.59	1102	6.67	1129	6.68
7600	790	4.11	827	4.60	863	5.06	899	5.49	935	5.88	970	6.24	1004	6.55	1037	6.81	1069	7.01	1099	7.16	1127	7.24	1154	7.25
																					7.5 HP & Field Supplied Drive			

Table X: RPM Selection

Size (Tons)	Model	HP	Max BHP	Motor Sheave	Blower Sheave	6 Turns Open	5 Turns Open	4 Turns Open	3 Turns Open	2 Turns Open	1 Turn Open	Fully Closed
X	Y	5	5.75	1VP60	BK110	730	765	800	835	870	905	N/A
		7.5	8.63	1VP60	BK090	905	950	990	1035	1075	1120	N/A

Table 15: Air Flow Performance - Side Duct Application

J15ZJ (15 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																					
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive						Standard 5 HP & Drive								High Static 5 HP & Drive									
4000	727	1.14	765	1.47	806	1.77	848	2.04	891	2.29	934	2.52	977	2.73	1020	2.93	1061	3.12	1101	3.30	1138	3.48	1174	3.67
4400	753	1.51	792	1.84	832	2.14	874	2.41	917	2.66	960	2.88	1004	3.09	1046	3.29	1087	3.48	1127	3.67	1165	3.85	1200	4.03
4800	781	1.92	820	2.25	861	2.55	903	2.82	946	3.06	989	3.29	1032	3.50	1074	3.70	1116	3.89	1155	4.08	1193	4.26	1228	4.44
5200	812	2.37	850	2.70	891	3.00	933	3.27	976	3.52	1019	3.74	1062	3.95	1105	4.15	1146	4.34	1186	4.53	1223	4.71	1259	4.89
5600	844	2.86	882	3.19	923	3.49	965	3.76	1008	4.01	1051	4.23	1094	4.45	1137	4.64	1178	4.83	1218	5.02	1255	5.20	1291	5.39
6000	877	3.39	916	3.72	957	4.02	999	4.29	1042	4.54	1085	4.76	1128	4.98	1170	5.17	1212	5.36	1251	5.55	1289	5.73	-	-
6400	912	3.96	951	4.29	992	4.59	1034	4.86	1077	5.10	1120	5.33	1163	5.54	1205	5.74	-	-	-	-	-	-	-	-
6800	949	4.56	988	4.89	1028	5.19	1070	5.46	1113	5.71	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7200	986	5.20	1025	5.53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																			5 HP & Field Supplied Drive					

1. Blower performance includes gas heat exchangers and 2" filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.898.

J18ZJ (17.5 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																					
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive						Standard 5 HP & Drive										High Static 7.5 HP & Drive							
4400	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
4800	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
5200	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
5600	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
6000	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
6400	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
6800	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
7200	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
7600	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
8000	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
8400	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
8800	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
																			7.5 HP & Field Supplied Drive					

1. Blower performance includes gas heat exchangers and 2" filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.838.

J20ZJ (20 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																					
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive				Standard 5 HP & Drive										High Static 7.5 HP & Drive									
5200	663	1.34	700	1.83	736	2.29	772	2.72	808	3.11	843	3.47	877	3.78	910	4.04	942	4.24	972	4.39	1000	4.47	1027	4.48
5600	680	1.71	717	2.20	753	2.66	789	3.09	825	3.48	860	3.84	894	4.15	927	4.41	959	4.61	989	4.76	1017	4.84	1044	4.85
6000	699	2.11	735	2.60	772	3.06	808	3.49	844	3.88	879	4.24	913	4.55	946	4.80	977	5.01	1007	5.15	1036	5.24	1062	5.25
6400	719	2.55	756	3.03	792	3.49	828	3.92	864	4.32	899	4.67	933	4.98	966	5.24	998	5.45	1028	5.59	1056	5.67	1083	5.68
6800	742	3.02	778	3.51	814	3.97	850	4.40	886	4.79	921	5.15	955	5.46	988	5.72	1020	5.92	1050	6.07	1078	6.15	1105	6.16
7200	765	3.54	802	4.03	838	4.49	874	4.92	910	5.32	945	5.67	979	5.98	1012	6.24	1044	6.44	1074	6.59	1102	6.67	1129	6.68
7600	790	4.11	827	4.60	863	5.06	899	5.49	935	5.88	970	6.24	1004	6.55	1037	6.81	1069	7.01	1099	7.16	1127	7.24	1154	7.25
8000	817	4.72	853	5.21	890	5.67	926	6.10	962	6.50	997	6.85	1031	7.16	1064	7.42	1095	7.62	1125	7.77	1154	7.85	1180	7.86
8400	845	5.38	881	5.87	918	6.33	954	6.76	990	7.16	1025	7.51	1059	7.82	1092	8.08	1123	8.28	1153	8.43	1182	8.51	1208	8.52
8800	874	6.09	911	6.58	947	7.04	983	7.47	1019	7.86	1054	8.22	1088	8.53	-	-	-	-	-	-	-	-	-	-
9200	905	6.85	941	7.33	977	7.79	1014	8.22	1049	8.62	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9600	936	7.65	973	8.13	1009	8.59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10000	969	8.49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																			7.5 HP & Field Supplied Drive					

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.838.

J25ZJ (25 Ton) Side Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]															
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Low Static 7.5 HP & Field Supplied Drive				Low Static 7.5 HP & Drive											
6600	760	2.51	793	3.11	824	3.68	856	4.23	887	4.74	919	5.23	950	5.70	983	6.15
7000	775	2.99	808	3.60	839	4.17	871	4.71	902	5.22	934	5.72	966	6.19	998	6.64
7400	792	3.51	824	4.11	856	4.69	887	5.23	918	5.74	950	6.24	982	6.70	1014	7.16
7800	809	4.07	841	4.67	873	5.24	904	5.78	935	6.30	967	6.79	999	7.26	1031	7.71
8200	826	4.66	859	5.27	890	5.84	922	6.38	953	6.89	985	7.39	1016	7.86	1049	8.31
8600	845	5.30	877	5.90	909	6.47	940	7.01	972	7.53	1003	8.02	1035	8.49	1067	8.94
9000	864	5.97	896	6.57	928	7.14	960	7.69	991	8.20	1022	8.69	1054	9.16	1087	9.61
9400	884	6.68	916	7.28	948	7.86	980	8.40	1011	8.91	1042	9.41	1074	9.88	1107	10.33
9800	905	7.43	937	8.04	969	8.61	1000	9.15	1032	9.67	1063	10.16	1095	10.63	1127	11.08
10200	926	8.22	958	8.83	990	9.40	1021	9.94	1053	10.46	1084	10.95	1116	11.42	1148	11.87
10600	948	9.05	980	9.66	1012	10.23	1043	10.77	1075	11.29	1106	11.78	1138	12.25	1170	12.70
11000	970	9.92	1003	10.52	1034	11.09	1066	11.64	1097	12.15	1128	12.64	1160	13.11	1193	13.56
11400	993	10.82	1025	11.43	1057	12.00	1089	12.54	1120	13.06	1151	13.55	1183	14.02	1216	14.47
11800	1017	11.76	1049	12.37	1081	12.94	1112	13.48	1143	14.00	1175	14.49	1207	14.96	1239	15.41
12200	1040	12.74	1073	13.34	1104	13.91	1136	14.46	1167	14.97	1199	15.46	1231	15.93	1263	16.38
12600	1065	13.75	1097	14.35	1129	14.92	1160	15.47	1192	15.98	1223	16.47	1255	16.94	-	-
	High Static 15 HP & Drive															

Standard 10 HP & Drive

Air Flow (CFM)	Available External Static Pressure - IWG[1]															
	2.0		2.2		2.4		2.6		2.8		3.0		3.2		3.4	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 10 HP & Drive										High Static 15 HP & Drive					
6600	1016	6.59	1050	7.00	1086	7.41	1123	7.81	1161	8.19	1202	8.58	1244	8.95	1289	9.33
7000	1031	7.07	1065	7.49	1101	7.89	1138	8.29	1176	8.68	1217	9.06	1259	9.44	1304	9.82
7400	1047	7.59	1081	8.01	1117	8.41	1154	8.81	1192	9.20	1233	9.58	1275	9.96	1320	10.34
7800	1064	8.14	1098	8.56	1134	8.97	1171	9.36	1209	9.75	1250	10.13	1292	10.51	1337	10.89
8200	1082	8.74	1116	9.16	1152	9.56	1189	9.96	1227	10.35	1268	10.73	1310	11.11	1355	11.49
8600	1101	9.37	1135	9.79	1170	10.20	1207	10.59	1246	10.98	1286	11.36	1329	11.74	1374	12.12
9000	1120	10.05	1154	10.46	1189	10.87	1226	11.27	1265	11.65	1305	12.04	1348	12.41	1393	12.79
9400	1140	10.76	1174	11.18	1209	11.58	1246	11.98	1285	12.37	1325	12.75	1368	13.13	1413	13.51
9800	1160	11.51	1195	11.93	1230	12.33	1267	12.73	1306	13.12	1346	13.50	1389	13.88	1434	14.26
10200	1182	12.30	1216	12.72	1251	13.12	1288	13.52	1327	13.91	1367	14.29	1410	14.67	1455	15.05
10600	1204	13.13	1238	13.55	1273	13.95	1310	14.35	1349	14.74	1389	15.12	1432	15.50	1477	15.88
11000	1226	14.00	1260	14.41	1296	14.82	1332	15.22	1371	15.60	1412	15.99	1454	16.36	1499	16.74
11400	1249	14.90	1283	15.32	1318	15.72	1355	16.12	1394	16.51	1434	16.89	-	-	-	-
11800	1272	15.84	1306	16.26	1342	16.66	1379	17.06	-	-	-	-	-	-	-	-
12200	1296	16.82	1330	17.23	-	-	-	-	-	-	-	-	-	-	-	-
12600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	15 HP & Field Supplied Drive															

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.82.

Table 16: Air Flow Performance - Bottom Duct Application

J15ZJ (15 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																							
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive				Standard 5 HP & Drive								High Static 5 HP & Drive											
4000	768	1.24	806	1.55	846	1.83	888	2.09	930	2.32	972	2.53	1015	2.73	1056	2.91	1097	3.09	1136	3.27	1173	3.44	1208	3.61
4400	797	1.65	835	1.96	875	2.24	916	2.49	959	2.72	1001	2.93	1043	3.13	1085	3.32	1126	3.50	1165	3.67	1202	3.84	1237	4.02
4800	828	2.09	866	2.40	906	2.68	947	2.93	989	3.16	1032	3.38	1074	3.58	1116	3.76	1157	3.94	1196	4.11	1233	4.28	1267	4.46
5200	860	2.57	898	2.88	938	3.16	980	3.41	1022	3.65	1064	3.86	1107	4.06	1148	4.24	1189	4.42	1228	4.59	1265	4.77	1300	4.94
5600	894	3.09	932	3.40	972	3.68	1014	3.93	1056	4.16	1098	4.38	1141	4.57	1182	4.76	1223	4.94	1262	5.11	1299	5.28	1334	5.46
6000	930	3.64	968	3.95	1008	4.23	1049	4.48	1091	4.71	1134	4.93	1176	5.12	1218	5.31	1259	5.49	1298	5.66	-	-	-	-
6400	966	4.22	1005	4.53	1045	4.81	1086	5.06	1128	5.30	1171	5.51	1213	5.71	-	-	-	-	-	-	-	-	-	-
6800	1005	4.84	1043	5.14	1083	5.42	1124	5.68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7200	1044	5.48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
																	5 HP & Field Supplied Drive							

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.898.

J18ZJ (17.5 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																							
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive				Standard 5 HP & Drive												High Static 7.5 HP & Drive							
4400	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
4800	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
5200	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
5600	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
6000	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
6400	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
6800	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
7200	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
7600	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
8000	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
8400	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
8800	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
																	7.5 HP & Field Supplied Drive							

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.838.

J20ZJ (20 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]																					
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		1.8		2.0		2.2		2.4		2.6	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 5 HP & Field Supplied Drive		Standard 5 HP & Drive												High Static 7.5 HP & Drive									
5200	694	1.43	730	1.89	766	2.32	801	2.72	836	3.09	871	3.42	904	3.71	937	3.95	968	4.14	997	4.28	1025	4.35	1051	4.37
5600	713	1.82	749	2.27	785	2.71	820	3.11	856	3.48	890	3.81	923	4.10	956	4.34	987	4.53	1017	4.67	1045	4.74	1071	4.75
6000	734	2.25	770	2.70	806	3.13	841	3.53	877	3.90	911	4.23	944	4.52	977	4.77	1008	4.96	1038	5.09	1066	5.17	1092	5.18
6400	757	2.71	793	3.17	829	3.60	864	4.00	899	4.37	934	4.70	967	4.99	1000	5.23	1031	5.42	1060	5.56	1088	5.64	1114	5.65
6800	781	3.22	817	3.68	853	4.11	888	4.51	923	4.88	958	5.21	991	5.50	1024	5.74	1055	5.94	1085	6.07	1112	6.15	1139	6.16
7200	807	3.78	843	4.23	878	4.66	914	5.07	949	5.44	983	5.77	1017	6.06	1049	6.30	1081	6.49	1110	6.63	1138	6.70	1164	6.71
7600	834	4.38	870	4.83	905	5.26	941	5.67	976	6.04	1010	6.37	1044	6.66	1076	6.90	1108	7.09	1137	7.23	1165	7.30	1191	7.31
8000	862	5.02	898	5.48	934	5.91	969	6.31	1004	6.68	1039	7.01	1072	7.30	1105	7.55	1136	7.74	1166	7.87	1194	7.95	1220	7.96
8400	892	5.71	928	6.17	963	6.60	999	7.00	1034	7.37	1069	7.70	1102	7.99	1134	8.24	1166	8.43	1195	8.56	-	-	-	-
8800	923	6.45	959	6.91	994	7.34	1030	7.74	1065	8.11	1099	8.44	-	-	-	-	-	-	-	-	-	-	-	-
9200	955	7.23	991	7.68	1026	8.11	1062	8.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9600	988	8.05	1024	8.51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
															7.5 HP & Field Supplied Drive									

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.838.

J25ZJ (25 Ton) Bottom Duct

Air Flow (CFM)	Available External Static Pressure - IWG[1]														
	0.4		0.6		0.8		1.0		1.2		1.4		1.6		
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	
	Low Static 7.5 HP & Field Supplied Drive		Low Static 7.5 HP & Drive												
6600	787	2.67	819	3.23	850	3.76	881	4.27	912	4.75	943	5.21	974	5.65	
7000	804	3.18	835	3.74	867	4.27	898	4.78	928	5.26	959	5.72	991	6.16	
7400	821	3.72	853	4.28	884	4.82	915	5.32	946	5.80	977	6.26	1008	6.70	Standard 10 HP & Drive
7800	839	4.30	871	4.86	902	5.40	933	5.90	964	6.39	995	6.85	1026	7.28	
8200	858	4.92	890	5.48	921	6.02	952	6.52	983	7.01	1013	7.47	1045	7.90	
8600	877	5.58	909	6.14	940	6.68	971	7.18	1002	7.66	1033	8.12	1064	8.56	
9000	898	6.28	929	6.84	960	7.37	991	7.88	1022	8.36	1053	8.82	1084	9.26	
9400	918	7.01	950	7.57	981	8.10	1012	8.61	1043	9.09	1074	9.55	1105	9.99	
9800	940	7.78	972	8.34	1003	8.87	1034	9.38	1064	9.86	1095	10.32	1127	10.76	
10200	962	8.58	994	9.14	1025	9.68	1056	10.18	1086	10.67	1117	11.13	1149	11.56	
10600	984	9.42	1016	9.98	1047	10.52	1078	11.02	1109	11.51	1140	11.96	1171	12.40	
11000	1007	10.30	1039	10.86	1070	11.39	1101	11.90	1132	12.38	1163	12.84	1194	13.28	
11400	1031	11.20	1063	11.76	1094	12.30	1125	12.80	1156	13.29	1187	13.75	1218	14.18	
11800	1055	12.14	1087	12.70	1118	13.24	1149	13.74	1180	14.23	1211	14.69	1242	15.12	
12200	1080	13.11	1111	13.68	1142	14.21	1173	14.72	1204	15.20	1235	15.66	1266	16.10	
12600	1104	14.12	1136	14.68	1167	15.21	1198	15.72	1229	16.20	1260	16.66	1291	17.10	
	High Static 15 HP & Drive														

Air Flow (CFM)	Available External Static Pressure - IWG[1]																	
	1.8		2.0		2.2		2.4		2.6		2.8		3.0		3.2		3.4	
	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
	Standard 10 HP & Drive										High Static 15 HP & Drive							
6600	1006	6.07	1039	6.48	1072	6.87	1107	7.25	1144	7.62	1182	7.98	1221	8.33	1263	8.68	1307	9.04
7000	1023	6.58	1055	6.98	1089	7.37	1124	7.75	1160	8.12	1198	8.48	1238	8.84	1280	9.19	1324	9.54
7400	1040	7.12	1072	7.53	1106	7.92	1141	8.30	1177	8.67	1215	9.03	1255	9.38	1297	9.74	1341	10.09
7800	1058	7.71	1090	8.11	1124	8.50	1159	8.88	1195	9.25	1233	9.61	1273	9.97	1315	10.32	1359	10.67
8200	1077	8.33	1109	8.73	1143	9.12	1178	9.50	1214	9.87	1252	10.23	1292	10.59	1334	10.94	1378	11.29
8600	1096	8.98	1129	9.39	1162	9.78	1197	10.16	1234	10.53	1272	10.89	1311	11.24	1353	11.60	1397	11.95
9000	1116	9.68	1149	10.08	1183	10.47	1218	10.85	1254	11.22	1292	11.58	1332	11.94	1373	12.29	1418	12.64
9400	1137	10.41	1170	10.82	1203	11.21	1238	11.59	1275	11.95	1313	12.32	1352	12.67	1394	13.02	1438	13.37
9800	1159	11.18	1191	11.59	1225	11.98	1260	12.35	1296	12.72	1334	13.09	1374	13.44	1416	13.79	1460	14.14
10200	1181	11.99	1213	12.39	1247	12.78	1282	13.16	1318	13.53	1356	13.89	1396	14.25	1438	14.60	1482	14.95
10600	1203	12.82	1236	13.23	1269	13.62	1304	14.00	1341	14.37	1379	14.73	1418	15.08	1460	15.44	1504	15.79
11000	1226	13.70	1259	14.10	1293	14.49	1327	14.87	1364	15.24	1402	15.60	1441	15.96	1483	16.31	1528	16.66
11400	1250	14.61	1282	15.01	1316	15.40	1351	15.78	1387	16.15	1425	16.51	1465	16.87	1507	17.22	-	-
11800	1274	15.55	1307	15.95	1340	16.34	1375	16.72	1411	17.09	-	-	-	-	-	-	-	-
12200	1298	16.52	1331	16.92	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	15 HP & Field Supplied Drive																	

1. Blower performance includes gas heat exchangers and 2” filters. See STATIC RESISTANCE table for additional applications.
2. See RPM SELECTION table to determine desired motor sheave setting and to determine the maximum continuous BHP.
3. kW = BHP x 0.82.

Table 17: RPM Selection

Size (Tons)	Model	HP	Max BHP	Motor Sheave	Blower Sheave	6 Turns Open	5 Turns Open	4 Turns Open	3 Turns Open	2 Turns Open	1 Turn Open	Fully Closed
J15 (15)	ZJ	5	5.75	1VP65	BK110	815	850	885	920	950	985	N/A
		5	5.75	1VP65	BK090	1010	1055	1095	1135	1180	1220	N/A
J18 (17.5)	ZJ	5	5.75	1VP60	BK110	730	765	800	835	870	905	N/A
		7.5	8.63	1VP60	BK090	905	950	990	1035	1075	1120	N/A
J20 (20)	ZJ	5	5.75	1VP60	BK110	730	765	800	835	870	905	N/A
		7.5	8.63	1VP60	BK090	905	950	990	1035	1075	1120	N/A
J25 (25)	ZJ	7.5	8.63	1VP60	1B5V94	810	850	885	920	960	1000	N/A
		10	11.50	1VP75X	1B5V110	975	1005	1040	1070	1100	1135	1165
		15	17.25	1VP75X	1B5V94	1140	1180	1215	1255	1290	1330	1365

Table 18: Indoor Blower Specifications

Size (Tons)	Model	Motor					Motor Sheave			Blower Sheave			Belt
		HP	RPM	Eff.	SF	Frame	Datum Dia. (in.)	Bore (in.)	Model	Datum Dia. (in.)	Bore (in.)	Model	
J15 (15)	ZJ	5	1725	0.89	1.15	184T	5.2 - 6.4	1 1/8	1VP65	10.4	1	BK110	BX83
		5	1725	0.89	1.15	184T	5.2 - 6.4	1 1/8	1VP65	8.4	1	BK090	BX81
J18 (17.5)	ZJ	5	1725	0.89	1.15	184T	4.2 - 5.5	1 1/8	1VP60	10.4	1 3/16	BK110	BX78
		7.5	1725	0.91	1.15	213T	4.2 - 5.5	1 3/8	1VP60	8.4	1 3/16	BK090	BX75
J20 (20)	ZJ	5	1725	0.89	1.15	184T	4.2 - 5.5	1 1/8	1VP60	10.4	1 3/16	BK110	BX78
		7.5	1725	0.91	1.15	213T	4.2 - 5.5	1 3/8	1VP60	8.4	1 3/16	BK090	BX75
J25 (25)	ZJ	7.5	1725	0.91	1.15	213T	4.2 - 5.5	1 3/8	1VP60	9.5	1 7/16	1B5V94	BX78
		10	1725	0.89	1.15	215T	5.8 - 7.0	1 3/8	1VP75X	11.1	1 7/16	1B5V110	5VX840
		15	1725	0.91	1.15	254T	6.2 - 7.4	1 5/8	1VP75X	9.5	1 7/16	1B5V94	5VX860

Table 19: Power Exhaust Specifications

Voltage	Motor			Motor			CFM @ 0.1 ESP
	HP	RPM[1]	QTY	LRA	FLA	MCA	
208/230-1-60	3/4	1075	1	7.7	5.0	6.25	5250
460-1-60	3/4	1075	1	4.1	2.2	2.75	5250
575-1-60	3/4	1050	1	2.84	1.5	1.875	5250

1. Motors are multi-tapped and factory wired for high speed.

Air Balance

⚠ CAUTION

On VAV units be certain that the VFD drive is set to maximum output, exhaust dampers are closed and individual space damper boxes are full open.

VFD units with bypass must not be in bypass mode ('LINE' position) unless all individual space dampers are full open.

Start the supply air blower motor. Adjust the resistances in both the supply and the return air duct systems to balance the air distribution throughout the conditioned space. The job specifications may require that this balancing be done by someone other than the equipment installer.

To check the supply air CFM after the initial balancing has been completed:

1. Remove the two 5/16" dot plugs from the blower motor and the filter access panels shown in the Unit Dimensions and Rear View Clearances Figure 6.
2. Insert at least 8" of 1/4 inch tubing into each of these holes for sufficient penetration into the air flow on both sides of the indoor coil.

NOTE: The tubes must be inserted and held in a position perpendicular to the air flow so that velocity pressure will not affect the static pressure readings.

3. Using an inclined manometer, determine the pressure drop across a dry evaporator coil. Since the moisture on an evaporator coil may vary greatly, measuring the pressure drop across a wet coil under field conditions would be inaccurate. To assure a dry coil, the compressors should be deactivated while the test is being run.

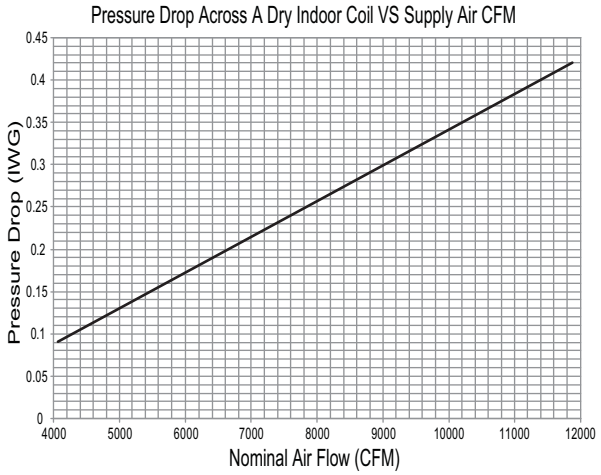


Figure 20: Pressure Drop Across A Dry Indoor Coil Vs. Supply Air CFM For All Unit Tonnages

4. Knowing the pressure drop across a dry coil, the actual CFM through the unit can be determined from the curve in Pressure Drop vs. Supply Air CFM Figure 20.

⚠WARNING

Failure to properly adjust the total system air quantity can result in extensive blower damage.

After readings have been obtained, remove the tubes and reinstall the two 5/16" dot plugs that were removed in Step 1.

NOTE: De-energize the compressors before taking any test measurements to assure a dry indoor coil.

Supply Air Drive Adjustment

The RPM of the supply air blower will depend on the required CFM, the unit accessories or options and the static resistances of both the supply and the return air duct systems. With this information, the RPM for the supply air blower and the motor pulley adjustment (turns open) can be determined from the Blower Performance Data Tables.

⚠ CAUTION

Belt drive blower systems MUST be adjusted to the specific static and CFM requirements for the application. The belt drive blowers are NOT set at the factory for any specific static or CFM. Adjustments of the blower speed and belt tension are REQUIRED. Tighten blower pulley and motor sheave set screws after these adjustments. Re-checking set screws after 10-12 hours run time is recommended.

High speed drive accessories (containing a smaller blower pulley and a shorter belt) are available for applications requiring the supply air blower to produce higher CFM's and/or higher static pressures. Use Model 1LD0460 for 15 ton units, Model 1LD0417 for 17.5 and 20 ton units, and Model 1LD0435 for 25 ton units. Refer to the Blower Motor and Drive Data Table 18.

Note the following:

1. The supply air CFM must be within the limitations shown in the Blower Performance Tables 15 and 16.
2. Pulleys can be adjusted in half turn increments.
3. The tension on the belt should be adjusted as shown in the Bet Adjustment, Figure 18.
4. Tighten blower pulley and motor sheave set screws after any adjustments. Re-check set screws after 10-12 hours run time recommended.

Additional Static Resistance

Size (Tons)	Model	CFM	Cooling Only[1]	Economizer[2 3]	Electric Heat kW[2]			
					18	36	54	72
J15 (15)	ZJ	4500	0.10	0.10	0.10	0.10	0.20	0.20
		6000	0.10	0.10	0.10	0.20	0.30	0.40
		7500	0.10	0.10	0.10	0.30	0.40	0.60
J18 (17.5) J20 (20) J25 (25)	ZJ	6000	0.10	0.10	0.10	0.10	0.20	0.20
		7500	0.10	0.10	0.10	0.20	0.30	0.40
		9000	0.15	0.15	0.10	0.30	0.40	0.60
		10500	0.15	0.15	0.20	0.40	0.60	0.80
		12000	0.20	0.20	0.30	0.50	0.70	0.90

1. Add these values to the available static resistance in the respective Blower Performance Tables.
2. Deduct these values from the available external static pressure shown in the respective Blower Performance Tables.
3. The pressure drop through the economizer is greater for 100% outdoor air than for 100% return air. If the resistance of the return air duct is less than 0.25 IWG, the unit will deliver less CFM during full economizer operation.

Operation

Cooling Sequence Of Operation

For J**ZJ units, the thermostat makes a circuit between “R” and “Y1” for the first stage of cooling.

The call is passed to the **Unit Control Board (UCB),** which then determines whether the requested operation is available and, if so, which components to energize.

For gas heating, the UCB monitors the "W1" call but does not handle the operation of the gas furnace. An ignition control board controls the gas heater operation. For electric heat units, the UCB passes the call to the electric heater. In both cases, when the "W1" call is sensed, the indoor air blower is energized following a specified heating delay.

If at any time a call for both heating and cooling are present, the heating operation will be performed. If operating, the cooling system is halted as with a completion of a call for cooling. Heating always takes priority.

Continuous Blower

By setting the room thermostat fan switch to "ON," the supply air blower will operate continuously.

Intermittent Blower

With the room thermostat fan switch set to "AUTO" and the system switch set to either the "AUTO" or "HEAT" settings, the blower is energized whenever a cooling or heating operation is requested. The blower is energized after any specified delay associated with the operation.

When energized, the indoor blower has a minimum run time of 30 seconds. Additionally, the indoor blower has a delay of 10 seconds between operations.

econds between operations.

Optional VAV Startup and Control

⚠ CAUTION

If the unit is operated with the manual bypass switch in the LINE (BYPASS) position and there are VAV boxes present in the duct system, then boxes must be driven to the full-open position using a customer-supplied power source to prevent over-pressurizing and possible damage to the ductwork.

For units with VFD and VAV control, the unit must first be put into the Occupied Mode to start operation. The default setting for all VAV units is 'Unoccupied', therefore the installer must add a jumper wire between terminals R - OCC on the VAV add-on board to put the unit into 'Occupied' Mode. Additionally, the unit can be switched between Unoccupied/Occupied mode through network communications with Simplicity™ PC and other BAS control systems.

Figure 21: Occupied Jumper

Once placed into the Occupied Mode, the speed of the indoor blower motor is controlled by duct static pressure. The Duct Static set point (default = 1.5") is the pressure that the VFD drive will maintain when operating the unit in VAV mode. If the duct static pressure reaches or exceeds the high-limit set-point (default = 4.5"), then the supply fan motor will be shutdown.

The Supply Air Temperature (SAT) is controlled by staging compressors on and off to satisfy the "Operating Cooling Supply Air Temp Set point". There are 3 set points that determine the resulting "Operating Cooling Supply Air Temp Set point".

1. VAV Cooling Supply Air Temp Upper Set point (default 60° F)
2. VAV Cooling Supply Air Temp Lower Set point (default 55° F)
3. VAV Supply Air Temp Reset Set point (default 72° F)

When the Return Air Temp (RAT) is above the "VAV Supply Air Temp Reset Set point" the SAT will be maintained at +/- 5 degrees of the "VAV Cooling Supply Air Temp Lower Set point".

When the Return Air Temp (RAT) is below the "VAV Supply Air Temp Reset Set point" the SAT will be maintained at +/- 5 degrees of the "VAV Cooling Supply Air Temp Upper Set point".

When the Outdoor air condition is sufficient for free cooling, the economizer will modulate to control the SAT to +/- 1 degrees of the operational set point.

The following components are needed to access the control points in the Simplicity® controller. Installation and operation guide is located on UPGNET.

1. Computer running Windows software with a standard USB port.

2. Simplicity® PC Software (**http://www.yorkupg.com/software.asp**)
3. Freenet USB adapter driver, (**http://www.yorkupg.com/software.asp**)
4. Simplicity® Freenet USB Adapter (S1-03101967000)
5. Freenet service cable (S1-02538682000)

No Outdoor Air Options

When the thermostat calls for the first stage of cooling, the low-voltage control circuit from “R” to “Y1” and “G” is completed. The UCB energizes the economizer (if installed and free cooling is available) or the first available compressor* and the condenser fans. For first stage cooling, compressor #1 is energized. If compressor #1 is unavailable, compressor #2 is energized. After completing the specified fan on delay for cooling, the UCB will energize the blower motor.

When the thermostat calls for the second stage of cooling, the low-voltage control circuit from “R” to “Y2” is completed. Compressor #2 is energized, provided it has not been locked out, and condenser fan motor #1, and condenser fan motor #2 remain energized. (If the ambient temperature is above 60ºF.)

If there is an initial call for more than one stage of cooling, the UCB will delay energizing compressors #2, #3 & #4 by 30 seconds each, depending on how many stages are called for, in order to avoid a power in-rush.

Once the thermostat has been satisfied, it will de-energize Y1, Y2, Y3 and Y4. If the compressors have satisfied their minimum run times, the compressors and condenser fans are de-energized. Otherwise, the unit operates each cooling system until the minimum run times for the compressors have been completed. Upon the final compressor de-energizing, the blower is stopped following the elapse of the fan off delay for cooling.

To be available, a compressor must not be locked-out due to a high or low-pressure switch or freezestat trip and the **Anti-Short Cycle Delay (ASCD)** must have elapsed.

These units utilize a lead-lag feature that results in an equal amount of run hours on all compressors, thereby extending the life of the compressors. This feature works as follows: If the thermostat requires for more than one stage of cooling, the currently off compressor with the least number of run hours will be the next to be energized. When the thermostat requires fewer stages of cooling, the currently running compressor with the most run hours will be the first to be de-energized.

Economizer With Single Enthalpy Sensor

When the room thermostat calls for “first-stage” cooling, the low voltage control circuit from “R” to “G” and “Y1” is completed. The UCB energizes the blower motor (if the fan switch on the room thermostat is set in the “AUTO” position) and drives the economizer dampers from fully closed to their minimum position. If the enthalpy of the outdoor air is below the set point of the enthalpy controller (previously determined), “Y1” energizes the economizer. The dampers will modulate to maintain a constant supply air temperature as monitored by the discharge air sensor. If the outdoor air enthalpy is above the set point, “Y1” energizes compressor #1.

When the thermostat calls for “second-stage” cooling, the low voltage control circuit from “R” to “Y2” is completed. The UCB energizes the first available compressor. If the enthalpy of the outdoor air is below the set point of the enthalpy controller (i.e. first stage has energized the economizer), “Y2” will energize compressor #1. If the outdoor air is above the set point, “Y2” will energize compressor #2. If Y2 brings on compressor #1 and this condition remains for more than 20 minutes, then compressor #2 will be energized until the thermostat is satisfied.

Once the thermostat has been satisfied, it will de-energize “Y1” and “Y2”. If the compressors have satisfied their minimum run times, the compressors and condenser fans are de-energized. Otherwise, the unit operates each cooling system until the minimum run times for the compressors have been completed. Upon the final compressor de-energizing, the blower is stopped following the elapse of the fan off delay for cooling, and the economizer damper goes to the closed position. If the unit is in continues fan operation, the economizer damper goes to the minimum position.

Economizer With Dual Enthalpy Sensors

The operation with the dual enthalpy sensors is identical to the single sensor except that a second enthalpy sensor is mounted in the return air. This return air sensor allows the economizer to choose between outdoor air and return air, whichever has the lowest enthalpy value, to provide maximum operating efficiency.

Economizer With Power Exhaust

A unit equipped with an economizer (single or dual enthalpy) and a power exhaust operates as specified above with one addition. The power exhaust motor is energized 45 seconds after the actuator position exceeds the exhaust fan set point on the economizer control. When the power exhaust is operating, the second stage of mechanical cooling will not operate. As always, the "R" to "G" connection provides minimum position but does not provide power exhaust operation.

Economizer With Optional VAV Or Intelli-comfort II™ Control

The position of the outside air and return air dampers are controlled through a 2-10 VDC signal from the VAV or Intelli-Comfort II™ control board. The economizer is enabled only in Occupied or Recovery mode. When the control is not powered or is in Unoccupied mode, the outside air dampers will be closed. When the supply fan is powered and there is no Y1 call, or if free-cooling is unavailable, the control opens the economizer dampers to the minimum position setting.

Free-cooling is available if the outdoor air temperature meets one of the three criteria discussed below, based upon the unit's configuration.

- **Dry Bulb:** The control refers to input from the Outside Air Temperature sensor and will allow free-cooling when the outdoor temperature is less than both the *First-Stage SAT Control* setpoint plus 5 °F, and the *Economizer OAT Enable* setpoint.
- **Single Enthalpy (optional):** A field-installed, Outdoor Air Humidity sensor is connected to the control. When the measured outdoor enthalpy is below the *Outside Air Enthalpy* setpoint, and the outdoor temperature is less than the *First-Stage SAT Control* setpoint plus 5 °F, free-cooling is available.
- **Dual Enthalpy (optional):** Both the field-installed Outdoor Air Humidity and the Return Air Humidity sensors are connected to the control. When the measured outdoor air enthalpy is less than the measured return air enthalpy, and the outdoor temperature is less than the *First-Stage SAT Control* setpoint plus 5 °F, free-cooling is available.

If free-cooling is available with a Y1 call, then the control modulates the economizer dampers to maintain the *First-Stage SAT Control* setpoint, plus or minus one degree. If free-cooling is unavailable, then 1st-stage mechanical cooling is initiated.

If at anytime the outdoor air temperature rises above the *First-Stage SAT Control* setpoint plus 5 °F, while free-cooling is available, then a Y1 call will also initiate 1st-stage mechanical cooling.

For a Y2 call, free-cooling is available based upon the criteria described above, except a *Second-Stage SAT Control* setpoint is used in the determination.

Once the call for cooling has been satisfied, it will de-energize any compressors and condenser fans, after the minimum compressor run times have been satisfied. Otherwise, the unit operates each cooling system until the minimum run times for the compressors have been completed.

Upon de-energizing the final compressor, the blower will continue to run with the economizer damper in its minimum position if in the Occupied mode; otherwise, the blower will stop following the elapse of the fan-off delay for cooling, and the economizer outdoor damper will close.

Economizer With Optional VAV Blower With Power Exhaust

The power exhaust motor is energized via the controller's EXH~ terminal and the ER relay, based on the position of the economizer damper parameter settings in the VAV control. Minimum run time is 10 seconds; minimum off time is 60 seconds. The outlet pressure of the power exhaust fan forces the barometric relief dampers open; gravity closes the dampers when the exhaust fan is off.

Economizer With Optional Intelli-comfort II™ With Power Exhaust

The power exhaust motor is energized via the exhaust relay based on the position of the economizer actuator's auxiliary switch adjustment screw. The adjustment screw represents the outdoor damper position at which to activate power exhaust, and can be set between 25 to 85 degrees open. The outlet pressure of the power exhaust fan forces the barometric relief dampers open; gravity closes the dampers when the exhaust fan is off.

Motorized Outdoor Air Dampers

This system operation is the same as the units with no outdoor air options with one exception. When the “R” to “G” circuit is complete, the motorized damper drives open to a position set by the thumbwheel on the damper motor. When the “R” to “G” circuit is opened, the damper spring returns fully closed.

Cooling Operation Errors

Each cooling system is monitored for operation outside of the intended parameters. Errors are handled as described below. All system errors override minimum run times for compressors.

High-Pressure Limit Switch

During cooling operation, if a high-pressure limit switch opens, the UCB will de-energize the associated compressor, initiate the ASCD (Anti-short cycle delay), and, if the other compressor is idle, stop the condenser fans. If the call for cooling is still present at the conclusion of the ASCD, the UCB will re-energize the halted compressor.

Should a high-pressure switch open three times within two hours of operation, the UCB will lock-out the associated compressor and flash a code (see Table 25). If the other compressor is inactive, the condenser fans will be de-energized.

Low-Pressure Limit Switch

The low-pressure limit switch is not monitored during the initial 30 seconds of a cooling system's operation. For the following 30 seconds, the UCB will monitor the low-pressure switch to ensure it closes. If the low-pressure switch fails to close after the 30-second monitoring phase, the UCB will de-energize the associated compressor, initiate the ASCD, and, if the other compressor is idle, stop the condenser fans. If the LPS is still open after the ASCD, the compressor will not be energized for 30 seconds. The second and third times that the UCB sees an open LPS will count towards the three occurrences that will cause a UCB lock-out.

Once the low-pressure switch has been proven (closed during the 30-second monitor period described above), the UCB will monitor the low-pressure limit switch for any openings. If the low-pressure switch opens for greater than 5 seconds, the UCB will de-energize the associated compressor, initiate the ASCD, and, if the other compressor is idle, stop the condenser fans.

If the call for cooling is still present at the conclusion of the ASCD, the UCB will re-energize the halted compressor.

Should a low-pressure switch open three times within one hour of operation, the UCB will lock-out the associated compressor and flash a code (Table 25). If the other compressor is inactive, the condenser fans will be de-energized.

Freezestat

During cooling operation, if a freezestat opens, the UCB will de-energize the associated compressor, initiate the ASCD, and, if the other compressor is idle, stop the condenser fans. If the call for cooling is still present at the conclusion of the ASCD, the UCB will re-energize the halted compressor.

Should a freezestat open three times within two hours of operation, the UCB will lock-out the associated compressor and flash a code (Table 25). If the other compressor is inactive, the condenser fans will be de-energized.

Low Ambient Cooling

To determine when to operate in low ambient mode, the UCB has a pair of terminals connected to a temperature-activated switch set at 45ºF. When the low ambient switch is closed and the thermostat is calling for cooling, the UCB will operate in the low ambient mode.

Low ambient mode operates the compressors in this manner: 10 minutes on, 5 minutes off. The indoor blower is operated throughout the cycle. The 5-minute off period is necessary to defrost the indoor coil.

Low ambient mode always begins with compressor operation. Compressor minimum run time may extend the minutes of compressor operation. The defrost cycle will begin immediately following the elapse of the minimum run time.

When operating in low ambient mode, the UCB will not lockout the compressors due to a freezestat trip. However, a freezestat trip will de-energize the associated compressor. If the call for cooling is still present at the end of the ASCD and the freezestat has closed, the unit will resume operation.

Safety Controls

The unit control board monitors the following inputs for each cooling system:

1. A suction line freezestat to protect against low evaporator temperatures due to a low airflow or a low return air temperature, (opens at 26 ± 5 °F and resets at 38 ± 5°F).
2. A high-pressure switch to protect against excessive discharge pressures due to a blocked condenser coil or a condenser motor failure, (opens at 625 ± 25 psig and resets 500 ± 25 psig).
3. A low-pressure switch to protect against loss of refrigerant charge, (opens at 50 ± 5 psig and resets at 71 ± 5 psig).

The above pressure switches are hard-soldered to the unit. The refrigeration systems are independently monitored and controlled. On any fault, only the associated system will be affected by any safety/preventive action. The other refrigerant system will continue in operation unless it is affected by the fault as well.

The unit control board monitors the temperature limit switch of electric heat units and the temperature limit switch and the gas valve of gas furnace units.

Compressor Protection

In addition to the external pressure switches, the compressors also have inherent (internal) protection. If there is an abnormal temperature rise in a compressor, the protector will open to shut down the compressor. The UCB incorporates features to minimize compressor wear and damage. An **Anti-Short Cycle Delay (ASCD)** is utilized to prevent operation of a compressor too soon after its previous run. Additionally, a minimum run time is imposed any time a compressor is energized.

The ASCD is initiated on unit start-up and on any compressor reset or lock-out.

Flash Codes

The UCB will initiate a flash code associated with errors within the system. Refer to UNIT CONTROL BOARD FLASH CODES Table 25.

Reset

Remove the call for cooling, by raising thermostat setting higher than the conditioned space temperature. This resets any pressure or freezestat flash codes.

Electric Heating Sequence Of Operations

The following sequence describes the operation of the electric heat section.

⚠ CAUTION

For units with VFD and electric heat, the speed of the indoor blower motor continues to be controlled by duct static pressure via the VAV control board.

If there are VAV boxes present in the duct system, the boxes must be driven to the full-open position using a customer-supplied power source to assure adequate airflow across the heating elements.

Single-stage heating: (applies only to 18 KW heater, all other heaters MUST use a two-stage thermostat)

a. Upon a call for heat by the thermostat, the heater contactor (6M) will be energized. After completing the specified fan on delay for heating, the UCB will energize the blower motor.

b The thermostat will cycle the electric heat to satisfy the heating requirements of the conditioned space.

Two-stage heating: (applies to all heaters except 18 KW)

a. Upon a call for first-stage heat by the thermostat, the heater contactor (6M) (6M & 7M on 72 KW, 240V) will be energized. After completing the specified fan on delay for heating, the UCB will energize the blower motor.

If the second stage of heat is required, heater contactor (7M) will be energized. Note that on the 54 KW, 240V heater, heater contactors (7M & 8M) will be energized and

on the 72 KW, 240V heater, heater contactors (8M & 9M) will be energized. After completing the specified fan on delay for heating, the UCB will energize the blower motor.

b The thermostat will cycle the electric heat to satisfy the heating requirements of the conditioned space.

NOTE: All 240 & 480V heaters are provided with manual reset backup protection limits. These will de-energize the heaters should the primary limit fail to open or the contactors fail to open in a failure mode.

Electric Heat Operation Errors

Temperature Limit

If the UCB senses zero volts from the high temperature limit, the indoor blower motor is immediately energized.

This limit is monitored regardless of unit operation status, i.e. the limit is monitored at all times.

If the temperature limit opens three times within one hour, it will lock-on the indoor blower motor and a flash code is initiated (See Table 25).

Safety Controls

The UCB monitors the temperature limit switch of electric heat units.

The control circuit includes the following safety controls:

Temperature Limit Switch (TLs)

1. Temperature Limit Switch (TLS 1, 2).

   This control is located inside the heater compartment and is set to open at the temperature indicated in the Limit Control Setting Table 20. It resets automatically. The limit switch operates when a high temperature condition, caused by inadequate supply air flow occurs, thus shutting down the heater and energizing the blower.

2. Temperature Limit Switch (TLS 3, 4, 5 and 6).

   This control is located inside the heater compartment and is set to open at the temperature indicated in the Limit Control Setting Table 20. It is a manual reset limit. These limit switches will de-energize the heaters should the primary limit fail to open or the contactors fail to open in a failure mode.

Table 20: Limit Control Setting

Unit (Tons)	Voltage	Heater Kw	Temperature, Limit Switch 1, 2 Opens, °F	Temperature, Limit Switch 3, 4, 5, 6 Opens, °F
15	240	18	120	170
		36	120	170
		54	120	170
		72	120	170

Table 20: Limit Control Setting

Unit (Tons)	Voltage	Heater Kw	Temperature, Limit Switch 1, 2 Opens, °F	Temperature, Limit Switch 3, 4, 5, 6 Opens, °F
17.5, 20 and 25	240	18	140	200
		36	140	200
		54	140	200
		72	140	200
15, 17.5, 20 and 25	460	18	120	170
		36	120	170
		54	120	170
		72	120	170
15, 17.5, 20 and 25	600	18	120	-
		36	120	-
		54	120	-
		72	120	-

Flash Codes

The UCB will initiate a flash code associated with errors within the system. Refer to UNIT CONTROL BOARD FLASH CODES Table 25.

Reset

Remove the call for heating by lowering the thermostat setting lower than the conditioned space temperature.This resets any flash codes.

Electric Heat Anticipator Setpoints

It is important that the anticipator setpoint be correct. Too high of a setting will result in longer heat cycles and a greater temperature swing in the conditioned space. Reducing the value below the correct setpoint will give shorter “ON” cycles and may result in the lowering of the temperature within the conditioned space. Refer to Table 21 for the required electric heat anticipator setting.

Table 21: Electric Heat Anticipator Setpoint

Heater Kw	Voltage	Setting, Amps	
		Th1	Th2
18	208/230-3-60	0.29	-
36		0.29	0.29
54		0.29	0.58
72		0.29	0.58
18	460-3-60	0.29	-
36		0.29	0.29
54		0.29	0.29
72		0.29	0.29
18	575-3-60	0.29	-
36		0.29	0.29
54		0.29	0.29
72		0.29	0.29

Gas Heating Sequence Of Operations

The following sequence describes the operation of the gas heat section.

⚠ CAUTION

For units with VFD and gas heat, the speed of the indoor blower motor continues to be controlled by duct static pressure via the VAV control board.

If there are VAV boxes present in the duct system, the boxes must be driven to the full-open position using a customer-supplied power source to assure adequate airflow across the heat exchanger tubes.

When the thermostat calls for the first stage of heating, the low-voltage control circuit from “R” to “W1” and “G” is completed, thru the UCB. The heat relay “RW1” is energized. The “RW1-2” contacts close energizing the draft motor control. The draft motor control contacts close and start the draft motor. As the speed of the draft motor reaches approximately 2500 RPM, the centrifugal switch contact, located on the end of the draft motor shaft, closes to power the first stage ignition module “IC1”, thru the “RW1-1” contacts.

Ignition module “IC1” will immediately start the first stage igniter sparking and will open the redundant valve located inside the first stage main gas valve “GV1” to allow a flow of gas to only the first stage carryover tube. Only after the pilot flame has been ignited and the presence of pilot flame detected at the “IC1” by a signal sent back through the flame sensor is sparking terminated and the first stage main gas valve opened.

Gas flows into each of the main burners and is ignited from the carryover tube flame.

After completing the specified fan on delay for heating, the UCB will energize the blower motor.

If “IC1” fails to detect a pilot flame, it will continue to try for a maximum of 85 seconds to ignite the pilot tube. If the pilot flame is not detected, then “IC1” will lock out first stage furnace operation for five minutes or until 24V power is removed from the module either at the unit or by resetting the room thermostat.

When the thermostat calls for the second stage of heating, the low-voltage control circuit from “R” to “W2” is completed, thru the UCB. Heat relay “RW2” is energized. The “RW2-1” contact is closed energizing the second stage ignition module “IC2”. “IC2” will immediately start the second stage igniter sparking and will open the redundant valve located inside the second stage main gas valve “GV2” to allow a flow of gas to the second stage carryover tube. Only after the pilot flame has been ignited and the presence of pilot flame detected at “IC2” by a signal sent back through the flame sensor is sparking terminated and the main gas valve opened.

Gas flows into each of the second stage main burners and is ignited from the carryover tube flame.

If “IC2” fails to detect a pilot flame, it will continue to try for a maximum of 85 seconds to ignite the pilot tube. If the pilot flame is not detected, then “IC2” will lock out first stage furnace operation for five minutes or until 24V power is removed from the module either at the unit or by resetting the room thermostat.

NOTE: That the second stage furnace can operate even if first stage has locked out.

When the thermostat satisfies de-energizing the “RW2”and “RW1”, thus opening all gas valves. The blower motor will continue to run after the furnace is shut down until the specified fan off delay for heating has been satisfied. The UCB will de-energize the blower motor.

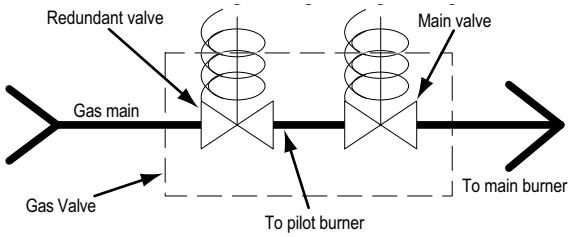


Figure 22: Gas Valve Piping

When the thermostat calls for the first stage of heating, the low-voltage control circuit from “R” to “W1” is completed. A call for heat passes through the UCB to the ignition control board (ICB). The UCB monitors the “W1” call and acts upon any call for heat. Once voltage has been sensed at “W1”, the UCB will initiate the fan on delay for heating, energizing the indoor blower after the specified delay has elapsed.

When the thermostat has been satisfied, heating calls are ceased. The GV is immediately de-energized. The blower is de-energized after the fan off delay for heating has elapsed. The draft motor performs a 25-second post purge.

Gas Heating Operation Errors

Temperature Limit

If the UCB senses zero volts from the high temperature limit, the indoor blower motor is immediately energized. When the UCB again senses 24 volts from the temperature limit, the draft motor will perform a 25-second post-purge and the indoor blower will be de-energized following the elapse of the fan off delay for heating.

This limit is monitored regardless of unit operation status, i.e. this limit is monitored at all times.

If the temperature limit opens three times within one hour, it will lock-on the indoor blower motor and flash code is initiated (See Table 25).

Gas Valve

The UCB continuously monitors the GV. Any time the UCB senses voltage at the GV without a call for heat for a continuous five-minute period, the UCB will lock-on the indoor blower and a flash code is initiated (Table 25). When voltage is no longer sensed at the GV, the UCB will de-energize the indoor blower following the elapse of the fan off delay for heating.

If voltage has been sensed at the GV for at least 15 seconds during the fan on delay for heating and GV voltage or “W1” is lost, the indoor blower is forced on for the length of the fan off delay for heating.

Safety Controls

The UCB monitors the temperature limit switch of gas heat units.

The control circuit includes the following safety controls:

Limit Switch (LS)

This control is located inside the gas heat compartment and is set to open at the temperature indicated in the Gas Heat Limit Control Settings Table 22. It resets automatically. The limit switch operates when a high temperature condition, caused by inadequate supply air flow occurs, thus shutting down the heater and energizing the blower.

Centrifugal Switch (CS)

If the draft motor should fail, the centrifugal switch attached to the shaft of the motor prevents the ignition controls and gas valves from being energized.

Redundant Gas Valve

There are two separate gas valves in the furnace. Each valve contains a main and a redundant valve. The redundant valves are located upstream of the main gas valves. Should either or both of the main gas valves fail in the open position the redundant valves serve as back-ups and shut off the flow of gas.

Flame Sensor Rod / 100% Ignition Control Lock-Out.

The flame rods and controls are located per Proper Flame Adjustment Figure 24. If an ignition control fails to detect a signal from the flame sensor indicating the pilot flame is properly ignited, then the main gas valve will not open. It will continue to try and ignite the pilot for a maximum of 85 seconds, then if the pilot flame is not detected, the ignition control will lock out furnace operation until 24V power is removed from the module either at the unit or by resetting the room thermostat.

Rollout Switch

This switch is located above the main burners in the control compartment, which in the event of a sustained main burner rollout shuts off and locks out both ignition controls closing both gas valves. The ignition controls lock out furnace operation until 24V power is removed from the controls either at the unit or by resetting the room thermostat.

Auxiliary Limit Switch (AUX)

This control is located inside the heat exchanger compartment and is set to open at 190°F. It is a manual reset switch. If AUX trips, then the primary limit has not functioned correctly. Replace the primary limit.

Table 22: Gas Heat Limit Control Setting

Units (Tons)	Capacity, MBH		Limit Control Opens, ºF
	Input	Output	
15, 17.5, 20 & 25	300	240	195
15, 17.5, 20 & 25	400	320	195

The ICB monitors the Pressure and Rollout switches of gas heat units.

The control circuit includes the following safety controls:

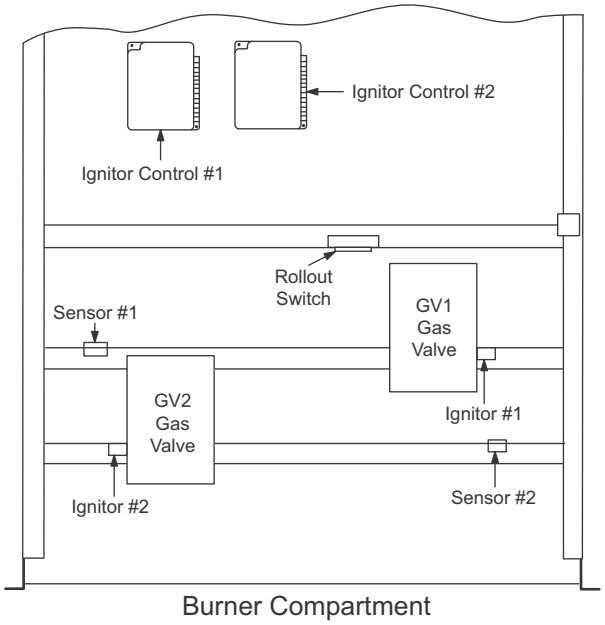


Figure 23: Gas Valve and Controls

Flash Codes

The UCB will initiate a flash code associated with errors within the system. Refer to UNIT CONTROL BOARD FLASH CODES Table 25.

Resets

Remove the call for heating by lowering the thermostat setting lower than the conditioned space temperature. This resets any flash codes.

Gas Heat Anticipator Setpoints

It is important that the anticipator setpoint be correct. Too high of a setting will result in longer heat cycles and a greater temperature swing in the conditioned space. Reducing the value below the correct setpoint will give shorter “ON cycles and may result in the lowering of the temperature within the conditioned space. Refer to Table 23 for the required gas heat anticipator setting.

Table 23: Gas Heat Anticipator Setpoints

Gas Valve	Anticipator Setpoint	
	1st Stage	2nd Stage
VR8440 36C68	0.30 amp	0.11 amp

Start-Up (Cooling)

Prestart Check List

After installation has been completed:

1. Check the electrical supply voltage being supplied. Be sure that it is the same as listed on the unit nameplate.
2. Set the room thermostat to the off position.
3. Turn unit electrical power on.
4. Set the room thermostat fan switch to on.
5. Check indoor blower rotation.
   - If blower rotation is in the wrong direction. Refer to Phasing Section in general information section.

   Check blower drive belt tension.
6. Check the unit supply air (CFM).
7. Measure evaporator fan motor's amp draw.
8. Set the room thermostat fan switch to off.
9. Turn unit electrical power off.

Operating Instructions

1. Turn unit electrical power on.
2. Set the room thermostat setting to lower than the room temperature.
3. First stage compressors will energize after the built-in time delay (five minutes).
4. The second stage of the thermostat will energize second stage compressor if needed.

Post Start Check List

1. Verify proper system pressures for both circuits.
2. Measure the temperature drop across the evaporator coil.
3. Measure the system amperage draw across all legs of 3 phase power wires.
4. Measure the condenser fan amperage draw.

Start-Up (Gas Heat)

Pre-Start Check List

Complete the following checks before starting the unit.

1. Check the type of gas being supplied. Be sure that it is the same as listed on the unit nameplate.
2. Make sure that the vent and combustion hoods have been properly installed.

Operating Instructions

⚠ CAUTION

This furnace is equipped with an intermittent pilot and automatic re-ignition system. DO NOT attempt to manually light the pilot.

Lighting The Main Burners

1. Turn “OFF” electric power to unit.
2. Turn room thermostat to lowest setting.
3. Turn gas valve knob or switch to “ON” position (See Figure 26).
4. Turn “ON” electric power to unit.
5. Set room thermostat to desired temperature (If thermostat “set” temperature is above room temperature, pilot burner ignition will occur and, after an interval to prove pilot flame, main burners will ignite).

Post Start Checklist

After the entire control circuit has been energized and the heating section is operating, make the following checks:

1. Check for gas leaks in the unit piping as well as the supply piping.

⚠ WARNING

FIRE OR EXPLOSION HAZARD

Failure to follow the safety warning exactly could result in serious injury, death or property damage.

Never test for gas leaks with an open flame. use a commercially available soap solution made specifically for the detection of leaks to check all connections. A fire or explosion may result causing property damage, personal injury or loss of life.

2. Check for correct manifold gas pressures. (See CHECKING GAS INPUT.)
3. Check the supply gas pressure. It must be within the limits shown on the rating nameplate. Supply pressure should be checked with all gas appliances in the building at full fire. At no time should the standby gas pressure exceed 13 in. or the operating pressure drop below 5.0 in for natural gas units. If gas pressure is outside these limits, contact the local gas utility or propane supplier for corrective action.

Shut Down

1. Set the thermostat to the lowest temperature setting.
2. Turn “OFF” all electric power to unit.
3. Open gas heat access panel.
4. Turn gas valve clockwise to “OFF” position (See Figure 26).

Checking Gas Heat Input

1. Turn off all other gas appliances connected to the gas meter.
2. With the furnace turned on, measure the time needed for one revolution of the hand on the smallest dial on the meter. A typical gas meter usually has a 1/2 or a 1 cubic foot test dial.
3. Using the number of seconds for each revolution and the size of the test dial increment, find the cubic feet of gas consumed per hour from the Gas Rate - Cubic Feet Per Hour Table 24.

If the actual input is not within 5% of the furnace rating (with allowance being made for the permissible range of the regulator setting), replace the orifice spuds with spuds of the proper size.

NOTE: To find the Btu input, multiply the number of cubic feet of gas consumed per hour by the Btu content of the gas in your particular locality (contact your gas company for this information - it varies widely from city to city.).

Table 24: Gas Rate Cubic Feet Per Hour

Seconds for One Rev.	Size of Test Dial	
	1/2 cu. ft.	1 cu. ft.
4	450	900
6	300	600
8	228	450
10	180	360
12	150	300
14	129	257
16	113	225
18	100	200
20	90	180
22	82	164
24	75	150
26	69	138
28	64	129

EXAMPLE

By actual measurement, it takes 13 seconds for the hand on the 1-cubic foot dial to make a revolution with just a 300,000 Btuh furnace running. Read across to the column in the table above, headed “1 Cubic Foot”, where you will see that 278 cubic feet of gas per hour are consumed by the furnace at that rate. Multiply 278 x 1050 (the Btu rating of the gas obtained from the local gas company). The result is 292,425 Btuh, which is close to the 300,000 Btuh rating of the furnace.

Manifold Gas Pressure Adjustment

Small adjustments to the high-fire gas flow may be made by turning the pressure regulator adjusting screw on the automatic gas valve.

Adjust as follows:

1. Remove the cap on the regulator. It's located next to the push-on electrical terminals.
2. To decrease the gas pressure, turn the adjusting screw counterclockwise.
3. To increase the gas pressure, turn the adjusting screw clockwise.

NOTE: The correct manifold pressure for these furnaces is 3.65 IWG ± 0.3.

Adjustment Of Temperature Rise

The temperature rise (the difference of temperature between the return air and the heated air from the furnace) must lie within the range shown on the CSA rating plate and the data in Table 11.

After the temperature rise has been determined, the CFM can be calculated as follows:

$$\text{CFM} = \text{Btu Input} \cdot \frac{0.8}{(1.08 \cdot \Delta^\circ\text{F})}$$

After about 20 minutes of operation, determine the furnace temperature rise. Take readings of both the return air and the heated air in the ducts (about 6 feet from the furnace) where they will not be affected by radiant heat. Increase the blower CFM to decrease the temperature rise; decrease the blower CFM to increase the rise (See SUPPLY AIR DRIVE ADJUSTMENT).

NOTE: Each gas heat exchanger size has a minimum allowable CFM. Below this CFM, the limit will open.

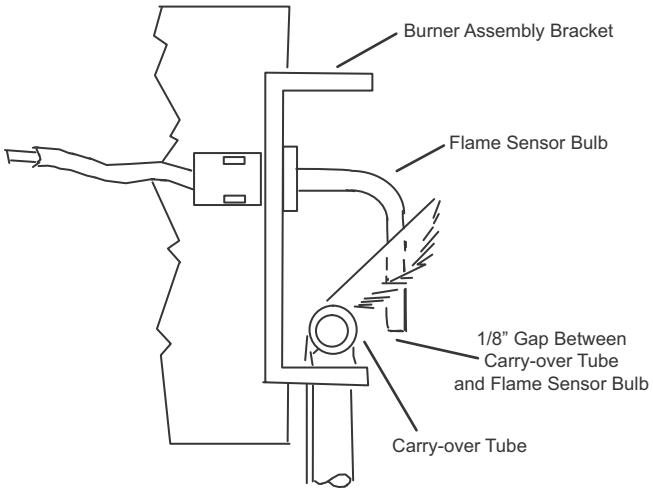


Figure 24: Proper Pilot Flame Adjustment

Pilot Checkout

The pilot flame should envelope the end of the flame sensor. To adjust pilot flame, (1) remove pilot adjustment cover screw, (2) increase or decrease the clearance for air to the desired level, (3) be sure to replace cover screw after adjustment to prevent possible gas leakage.

Put the system into operation and observe through complete cycle to be sure all controls function properly.

Burner Instruction

To check or change burners, pilot or orifices, CLOSE MAIN MANUAL SHUT-OFF VALVE AND SHUT OFF ALL ELECTRIC POWER TO THE UNIT.

1. Remove the screws holding either end of the manifold to the burner supports.
2. Open the union fitting in the gas supply line just upstream of the unit gas valve and downstream from the main manual shut-off valve.
3. Remove the gas piping closure panel.
4. Disconnect wiring to the gas valves and spark ignitors. Remove the manifold-burner gas valve assembly by lifting up and pulling back.

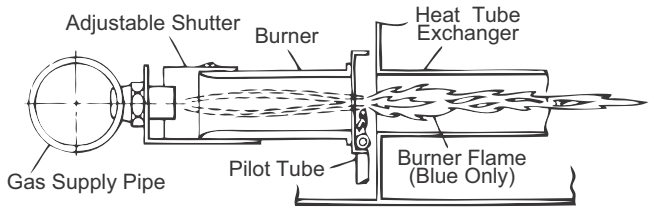


Figure 25: Typical Flame

Burners are now accessible for service.

Reverse the above procedure to replace the assemblies. Make sure that burners are level and seat at the rear of the heat exchanger.

Burner Air Shutter Adjustment

Adjust burner shutters so no yellow flame is observed in the heat exchanger tubes.

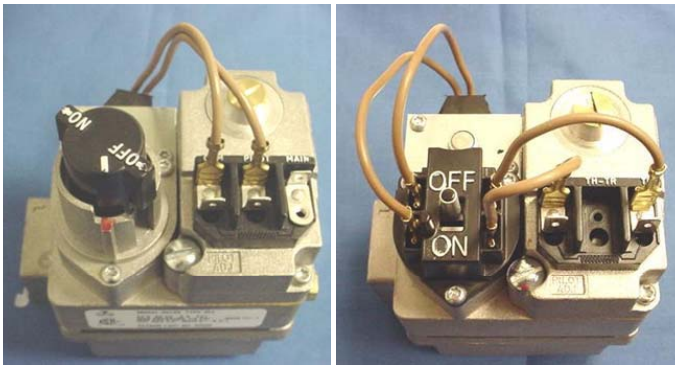


Figure 26: Typical Gas Valve

Charging The Unit

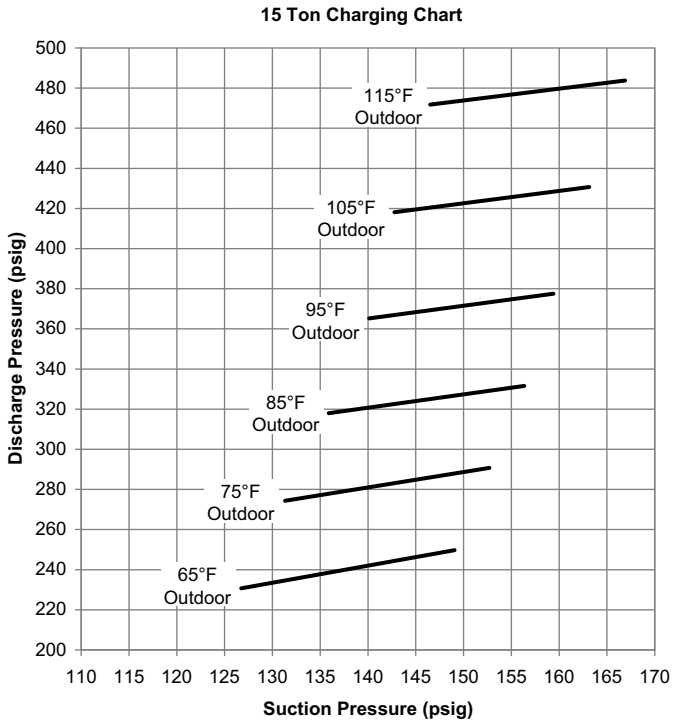


Figure 27: J15ZJ (15 Ton) Charging Chart

Figure 28: J18ZJ (17.5 Ton) Charging Chart

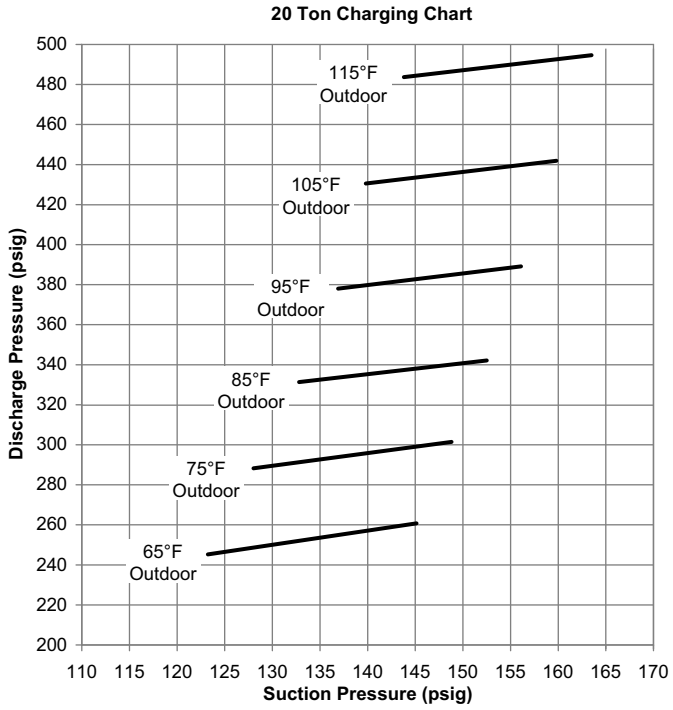


Figure 29: J20ZJ (20 Ton) Charging Chart

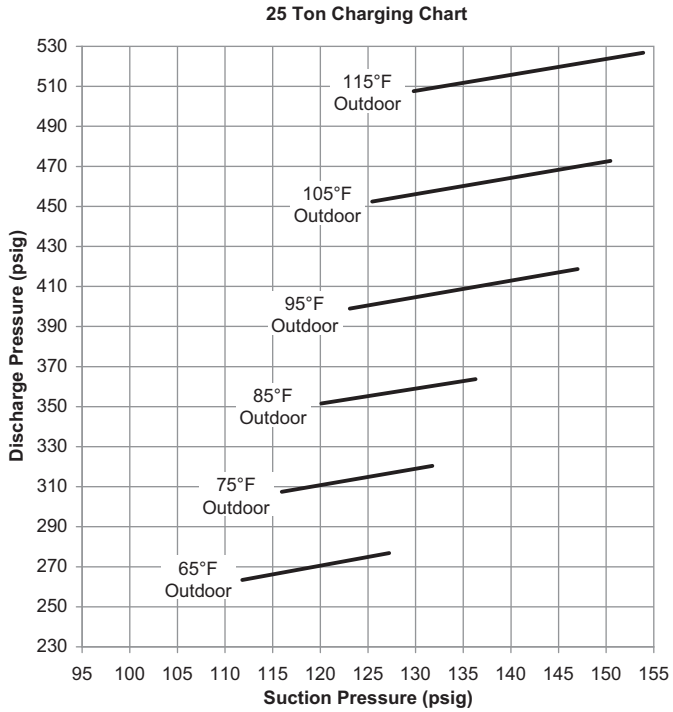


Figure 30: J25ZJ (25 Ton) Charging Chart

Troubleshooting

⚠WARNING

Troubleshooting of components may require opening the electrical control box with the power connected to the unit. **Use extreme care when working with live circuits!** Check the unit nameplate for the correct line voltage and set the voltmeter to the correct range before making any connections with line terminals.

For troubleshooting of optional VFD, disconnect all power to the drive. Be aware that high voltages are present in the drive even after power has been disconnected. Capacitors within the drive must be allowed to discharge before beginning service.

When not necessary, shut off all electric power to the unit prior to any of the following maintenance procedures so as to prevent personal injury.

⚠ CAUTION

Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation which could cause injury to person and/or damage unit components. Verify proper operation after servicing.

Cooling Troubleshooting Guide

On calls for cooling, if the compressors are operating but the supply air blower motor does not energize after a short delay (the room thermostat fan switch is in the “AUTO” position):

1. Turn the thermostat fan switch to the ON position. If the supply air blower motor does not energize, go to Step 2.
2. If the supply air blower motor does not energize when the fan switch is set to ON, check that line voltage is being supplied to the contacts of the M3, contactor, and that the contactor is pulled in. For units with VFD, check that line voltage is being supplied to the M3-Auxiliary contacts. Check for loose wiring between the contactor and the supply air blower motor.
3. If M3 is pulled in and voltage is supplied to M3, lightly touch the supply air blower motor housing. If it is hot, the motor may be off on internal protection. Cancel any thermostat calls and set the fan switch to AUTO. Wait for the internal overload to reset. Test again when cool.
4. If M3 is not pulled in, check for 24 volts at the M3 coil. If 24 volts are present at M3 but M3 is not pulled in, replace the contactor.
5. Failing the above, if there is line voltage supplied at M3, M3 is pulled in, and the supply air blower motor still does not operate, replace the motor.

   For units with VFD, if there is line voltage supplied at M3, M3 is pulled in, and the blower motor does not operate, check all power & control wiring connections to and from the drive and for any fault/warning messages displayed on the drive's digital display (refer to the drive user manual for full descriptions, if necessary). Clear any fault by pressing 'RESET' on the drive's keypad and take any corrective action as needed. If the motor still does not operate, replace the motor.
6. If 24 volts is not present at M3, check that 24 volts is present at the UCB supply air blower motor terminal, “FAN”. If 24 volts is present at the FAN, check for loose wiring between the UCB and M3.
7. If 24 volts is not present at the “FAN” terminal, check for 24 volts from the room thermostat. If 24 volts are not present from the room thermostat, check for the following:
   a. Proper operation of the room thermostat (contact between R and G with the fan switch in the ON position and in the AUTO position during operation calls).
   b. Proper wiring between the room thermostat and the UCB, and
   c. Loose wiring from the room thermostat to the UCB
8. If 24 volts is present at the room thermostat but not at the UCB, check for proper wiring between the thermostat and the UCB, i.e. that the thermostat G terminal is connected to the G terminal of the UCB, and for loose wiring.
9. If the thermostat and UCB are properly wired, replace the UCB.

On calls for cooling, the supply air blower motor is operating but compressor #1 is not (the room thermostat fan switch is in the “AUTO” position):

1. If installed, check the position of the economizer blades. If the blades are open, the economizer is providing free cooling and the compressors will not immediately operate. If both stages of cooling are requested simultaneously and the economizer provides free cooling, following a short delay compressor #1 will be energized unless it is locked out. If compressor #1 is locked out, compressor #2 is energized. Compressor #2 is always energized in place of compressor #1 when compressor #1 is requested but locked out.
2. If no economizer is installed or the economizer is not opening to provide free cooling and compressor #1 does not energize on a call for cooling, check for line voltage at the compressor contactor, M1, and that the contactor is pulled in. Check for loose wiring between the contactor and the compressor.
3. If M1 is pulled in and voltage is supplied at M1, lightly touch the compressor housing. If it is hot, the compressor may be off on inherent protection. Cancel any calls for cooling and wait for the internal overload to reset. Test again when cool.
4. If M1 is not pulled in, check for 24 volts at the M1 coil. If 24 volts are present and M1 is not pulled in, replace the contactor.
5. Failing the above, if voltage is supplied at M1, M1 is pulled in, and the compressor still does not operate, replace the compressor.
6. If 24 volts is not present at M1, check for 24 volts at the UCB terminal, C1. If 24 volts is present, check for loose wiring between C1 and the compressor contactor.

7. If 24 volts is not present at the C1 terminal, check for 24 volts from the room thermostat at the UCB Y1 terminal. If 24 volts is not present from the room thermostat, check for the following:
   a. 24 volts at the thermostat Y1 terminal
   b. Proper wiring between the room thermostat and the UCB, i.e. Y1 to Y1, Y2 to Y2, and
   c. Loose wiring from the room thermostat to the UCB
8. If 24 volts is present at the UCB Y1 terminal, the compressor may be out due to an open high-pressure switch, low-pressure switch, or freezestat. Check for 24 volts at the HPS1, LPS1, and FS1 terminals of the UCB. If a switch has opened, there should be a voltage potential between the UCB terminals, e.g. if LPS1 has opened, there will be a 24-volt potential between the LPS1 terminals.
9. If 24 volts is present at the UCB Y1 terminal and none of the protection switches have opened, the UCB may have locked out the compressor for repeat trips. The UCB should be flashing an alarm code. If not, press and release the ALARMS button on the UCB. The UCB will flash the last five alarms on the LED. If the compressor is locked out, cancel any call for cooling. This will reset any compressor lock outs. If the LPS is still open after the ASCD, the compressor will not be energized for 30 seconds. The second and third times that the UCB sees an open LPS will count towards the three occurrences that will cause a UCB lock-out.

NOTE: While the above step will reset any lockouts, compressor #1 may be held off for the ASCD. See the next step.

10. If 24 volts is present at the UCB Y1 terminal and none of the switches are open and the compressor is not locked out, the UCB may have the compressor in an ASCD. Check the LED for an indication of an ASCD cycle. The ASCD should time out within 5 minutes. Press and release the TEST button to reset all ASCDs.
11. If 24 volts is present at the UCB Y1 terminal and the compressor is not out due to a protective switch trip, repeat trip lock out, or ASCD, the economizer terminals of the UCB may be improperly wired. Check for 24 volts at the Y1 “OUT” terminal of the UCB. If 24 volts is present, trace the wiring from Y1 “OUT” for incorrect wiring. If 24 volts is not present at the Y1 “OUT” terminal, the UCB must be replaced.
12. *For units without economizers*: If 24 volts is present at the Y1 OUT terminal, check for 24 volts at the Y1 “ECON” terminal. If 24 volts is not present, check for loose wiring from the Y1 “OUT” terminal to the Mate-N-Lock plug, the jumper in the Mate-N-Lock plug, and in the wiring from the Mate-N-Lock plug to the Y1 “ECON” terminal.
13. *For units with economizers*: If 24 volts is present at the Y1 “OUT” terminal, check for 24 volts at the Y1 “ECON” terminal. If 24 volts is not present, check for loose wiring from the Y1 “OUT” terminal to the Mate-N-Lock plug, a poor connection between the UCB and economizer Mate-N-Lock plugs, loose wiring from the Mate-N-Lock plug to the economizer, back to the Mate-N-Lock plug, and from the Mate-N-Lock plug to the Y1 “ECON” terminal. If nothing is found, the economizer control may have faulted and is failing to return the 24-volt “call” to the Y1 “ECON” terminal even though the economizer is not providing free cooling. To test, disconnect the Mate-N-Locks and jumper between the WHITE and YELLOW wires of the UCB’s Mate-N-Lock plug. If compressor #1 energizes, there is a fault in the economizer wiring or the economizer control.
14. The UCB can be programmed to lock out compressor operation during free cooling and in low ambient conditions. These options are not enabled by default. Local distributors can test the UCB for this programming.

    For units with factory installed economizers, the UCB is programmed to lock out compressor operation when the LAS set point is reached.

    For units without factory installed or with field installed economizers, the UCB allows compressor operation all the time. This programming can be checked or changed by the local distributor.
15. If none of the above corrected the error, test the integrity of the UCB. Disconnect the C1 terminal wire and jumper it to the Y1 terminal. DO NOT jump the Y1 to C1 terminals. If the compressor engages, the UCB has faulted.
16. If none of the above correct the error, replace the UCB.

On calls for the second stage of cooling, the supply air blower motor and compressor #1 are operating but compressor #2 is not (the room thermostat fan switch is in the “AUTO” position):

1. If installed, check the position of the economizer blades. If the blades are open, the economizer is providing free cooling. If the second stage of cooling is requested, following a short delay, compressor #1 will be energized unless it is locked out. Typically, compressor #2 is energized only during free cooling if the call for the second stage of cooling persists for 20 minutes.
2. Compressor #2 will not energize simultaneously with compressor #1 if a call for both stages of cooling is received. The UCB delays compressor #2 by 30 seconds to prevent a power surge. If after the delay compressor #2 does not energize on a second stage call for cooling, check for line voltage at the compressor contactor, M2, and that the contactor is pulled in. Check for loose wiring between the contactor and the compressor.
3. If M2 is pulled in and voltage is supplied at M2, lightly touch the compressor housing. If it is hot, the compressor may be off on inherent protection. Cancel any calls for cooling and wait for the internal overload to reset. Test again when cool.
4. If M2 is not pulled in, check for 24 volts at the M2 coil. If 24 volts is present and M2 is not pulled in, replace the contactor.
5. Failing the above, if voltage is supplied at M2, M2 is pulled in, and the compressor still does not operate, replace the compressor.
6. If 24 volts is not present at M2, check for 24 volts at the UCB terminal, C2. If 24 volts are present, check for loose wiring between C2 and the compressor contactor.
7. If 24 volts is not present at the C2 terminal, check for 24 volts from the room thermostat at the UCB Y2 terminal. If

24 volts is not present from the room thermostat, check for the following:

a. 24 volts at the thermostat Y2 terminal

b. Proper wiring between the room thermostat and the UCB, i.e. Y1 to Y1, Y2 to Y2, and

c. Loose wiring from the room thermostat to the UCB

8. If 24 volts is present at the UCB Y2 terminal, the compressor may be out due to an open high-pressure switch, low-pressure switch, or freezestat. Check for 24 volts at the HPS2, LPS2, and FS2 terminals of the UCB. If a switch has opened, there should be a voltage potential between the UCB terminals, e.g. if LPS2 has opened, there will be 24 volts of potential between the LPS2 terminals.

9. If 24 volts is present at the UCB Y2 terminal and none of the protection switches have opened, the UCB may have locked out the compressor for repeat trips. The UCB should be flashing a code. If not, press and release the ALARMS button on the UCB. The UCB will flash the last five alarms on the LED. If the compressor is locked out,

   remove any call for cooling at the thermostat or by disconnecting the thermostat wiring at the Y1, Y2, Y3 and Y4 on the UCB terminal. This will reset any compressor lock outs, except LPS lockouts these can only be reset by cycling power to UCB.

NOTE: While the above step will reset any lock outs, compressor #1 will be held off for the ASCD, and compressor #2 may be held off for a portion of the ASCD. See the next step.

10. If 24 volts is present at the UCB Y2 terminal and none of the switches are open and the compressor is not locked out, the UCB may have the compressor in an ASCD. Check the LED for an indication of an ASCD cycle. The ASCD should time out within 5 minutes. Press and release the TEST button to reset all ASCDs.

11. The UCB can be programmed to lock out compressor operation during free cooling and in low ambient conditions. These options are not enabled by default. Local distributors can test the UCB for this programming.

    For units with factory installed economizers, the UCB is programmed to lock out compressor operation when the LAS set point is reached.

    For units without factory installed or with field installed economizers, the UCB allows compressor operation all the time. This programming can be checked or changed by the local distributor.

12. If none of the above corrected the error, test the integrity of the UCB. Disconnect the C2 terminal wire and jumper it to the Y2 terminal. DO NOT jump the Y2 to C2 terminals. If the compressor engages, the UCB has faulted.

13. If none of the above correct the error, replace the UCB.

On a call for cooling, the supply air blower motor and compressor #2 are operating but compressor #1 is not (the room thermostat fan switch is in the “AUTO” position):

1. Compressor #2 is energized in place of compressor #1 when compressor #1 is unavailable for cooling calls. Check the UCB for alarms indicating that compressor #1 is locked out. Press and release the ALARMS button if the LED is not flashing an alarm.

2. Check for line voltage at the compressor contactor, M1, and that the contactor is pulled in. Check for loose wiring between the contactor and the compressor.

3. If M1 is pulled in and voltage is supplied at M1, lightly touch the compressor housing. If it is hot, the compressor may be off on inherent protection. Cancel any calls for cooling and wait for the internal overload to reset. Test again when cool.

4. If M1 is not pulled in, check for 24 volts at the M1 coil. If 24 volts is present and M1 is not pulled in, replace the contactor.

5. Failing the above, if voltage is supplied at M1, M1 is pulled in, and the compressor still does not operate, replace the compressor.

6. If 24 volts is not present at M1, check for 24 volts at the UCB terminal, C1. If 24 volts is present, check for loose wiring between C1 and the compressor contactor.

7. If 24 volts is not present at the C1 terminal, check for 24 volts from the room thermostat at the UCB Y1 terminal. If 24 volts are not present at the UCB Y1 terminal, the UCB may have faulted. Check for 24 volts at the Y1 ECON terminal. If 24 volts is not present at Y1 “ECON”, the UCB has faulted. The UCB should de-energize all compressors on a loss of call for the first stage of cooling, i.e. a loss if 24 volts at the Y1 terminal.

8. If 24 volts are present at the UCB Y1 terminal, the compressor may be out due to an open high-pressure switch, low-pressure switch, or freezestat. Check for 24 volts at the HPS1, LPS1, and FS1 terminals of the UCB. If a switch has opened, there should be a voltage potential between the UCB terminals, e.g. if LPS1 has opened, there will be a 24-volt potential between the LPS1 terminals.

9. If 24 volts is present at the UCB Y1 terminal and none of the protection switches have opened, the UCB may have locked out the compressor for repeat trips. The UCB should be flashing a code. If not, press and release the ALARMS button on the UCB. The UCB will flash the last five alarms on the LED. If the compressor is locked out, remove any call for cooling. This will reset any compressor lock outs, except LPS lockouts. These can only be reset by cycling power to the UCB.

NOTE: While the above step will reset any lock outs, compressor #2 will be held off for the ASCD, and compressor #1 may be held off for a portion of the ASCD. See the next step.

10. If 24 volts is present at the UCB Y1 terminal and none of the switches are open and the compressor is not locked out, the UCB may have the compressor in an ASCD. Check the LED for an indication of an ASCD cycle. The ASCD should time out within 5 minutes. Press and release the TEST button to reset all ASCDs.

11. If 24 volts is present at the UCB Y1 terminal and the compressor is not out due to a protective switch trip, repeat trip lock out, or ASCD, the economizer terminals of the UCB may be improperly wired. Check for 24 volts at the Y1 “OUT”

terminal of the UCB. If 24 volts is present, trace the wiring from Y1 “OUT” for incorrect wiring. If 24 volts is not present at the Y1 “OUT” terminal, the UCB must be replaced.

12. *For units without economizers:* If 24 volts is present at the Y1 “OUT” terminal, check for 24 volts at the Y1 “ECON” terminal. If 24 volts is not present, check for loose wiring from the Y1 “OUT” terminal to the Mate-N-Lock plug, the jumper in the Mate-N-Lock plug, and in the wiring from the Mate-N-Lock plug to the Y1 “ECON” terminal.

    For units with economizers: If 24 volts is present at the Y1 “OUT” terminal, check for 24 volts at the Y1 “ECON” terminal. If 24 volts is not present, check for loose wiring from the Y1 “OUT” terminal to the Mate-N-Lock plug, a poor connection between the UCB and economizer Mate-N-Lock plugs, loose wiring from the Mate-N-Lock plug to the economizer, back to the Mate-N-Lock plug, and from the Mate-N-Lock plug to the Y1 “ECON” terminal. The economizer control may have faulted and is not returning the 24 volts to the Y1 “ECON” terminal even though the economizer is not providing free cooling. To test the economizer control, disconnect the Mate-N-Locks and jumper between the WHITE and YELLOW wires of the UCB’s Mate-N-Lock plug.

13. The UCB can be programmed to lock out compressor operation during free cooling and in low ambient conditions. These options are not enabled by default. They can be checked by local distributors.

    For units with factory installed economizers, the UCB is programmed to lock out compressor operation when the LAS set point is reached.

    For units without factory installed or with field installed economizers, the UCB allows compressor operation all the time. This programming can be checked or changed by the local distributor.

14. If none of the above corrected the error, test the integrity of the UCB. Disconnect the C1 terminal wire and jumper it to the Y1 terminal. DO NOT jump the Y1 to C1 terminals. If the compressor engages, the UCB has faulted.

15. If none of the above correct the error, replace the UCB.

Gas Heat Troubleshooting Guide

On calls for heating, the draft motor operates and the furnace lights but the supply air blower motor does not energize after a short delay (the room thermostat fan switch is in “AUTO” position).

⚠WARNING

The furnace may shut down on a high temperature condition during the procedure. If this occurs, the UCB energize the supply air blower motor until the high temperature limit has reset. Caution should be used at all times as the supply air blower may energize regardless of the room thermostat fan switch position.

For troubleshooting of optional VFD, disconnect all power to the drive. Be aware that high voltages are present in the drive even after power has been disconnected. Capacitors within the drive must be allowed to discharge before beginning service.

1. Place the thermostat fan switch in the “ON” position. If the supply air blower motor energizes, go to Step 9.
2. If the supply air blower motor does not energize when the fan switch is set to “ON,” check that line voltage is being supplied to the contacts of the M3 contactor, and that the contactor is pulled in. For units with VFD, check that line voltage is being supplied to the M3-Auxiliary contacts. Check for loose wiring between the contactor and the supply air blower motor.
3. If M3 is pulled in and voltage is supplied at M3, lightly touch the supply air blower motor housing. If it is hot, the motor may be off on inherent protection. Cancel any thermostat calls and set the fan switch to “AUTO”, wait for the internal overload to reset. Test again when cool.
4. If M3 is not pulled in, check for 24 volts at the M3 coil. If 24 volts is present at M3 but M3 is not pulled in, replace the contactor.
5. Failing the above, if there is line voltage supplied at M3, M3 is pulled in, and the supply air blower motor still does not operate, replace the motor.

    For units with VFD, if there is line voltage supplied at M3, M3 is pulled in, and the blower motor does not operate, check all power & control wiring connections to and from the drive and for any fault/warning messages displayed on the drive's digital display (refer to the drive user manual for full descriptions, if necessary). Clear any fault by pressing 'RESET' on the drive's keypad and take any corrective action as needed. If the motor still does not operate, replace the motor.

6. If 24 volts is not present at M3, check that 24 volts is present at the supply air blower motor terminal on the UCB. If 24 volts is present at the UCB terminal, check for loose wiring between the UCB and M3.
   a. If 24 volts is not present at the UCB supply air blower motor terminal, check for 24 volts from the room thermostat. If 24 volts is not present from the room thermostat, check for the following:
      - Proper operation of the room thermostat (contact between R and G with the fan switch in the “ON” position and in the “AUTO” position during operation calls.)
      - Proper wiring between the room thermostat and the UCB, and
      - Loose wiring from the room thermostat to the UCB
7. If 24 volts is present at the room thermostat but not at the UCB, check for proper wiring between the thermostat and the UCB, i.e. that the thermostat G terminal is connected to the G terminal of the UCB, and for loose wiring.
8. If the thermostat and UCB are properly wired, replace the UCB.
9. If the blower motor runs with the fan switch in the “ON” position but does not run shortly after the furnace has ignited when the fan switch is in the “AUTO” position, check the room thermostat for contact between R and G during “W1” calls.

On calls for heating, the supply air blower operates but the draft motor does not (the room thermostat fan switch is in the “AUTO” position).

1. The draft motor has inherent protection. If the motor shell is hot to the touch, wait for the internal overload to reset.
2. If the motor shell is cold with the room thermostat calling for heat, check for line voltage at the motor's Mate-N-Lok connector attached to the evaporator partition. If line voltage is present, replace the draft motor.
3. If line voltage is not present, check for line voltage at the heat relay (RW1) contacts in the main control box and check to see if the (RW1) is pulled in.
4. If the (RW1) relay is pulled in, check for a loose line voltage connection.
5. If the (RW1) relay is not pulled in, check for 24 volts at the (RW1) coil. If 24 volts is present, replace the (RW1) relay. If 24 volts is not present, check for a loose 24 volt connection back to the relay board and check the connections from the room thermostat to the relay board. If all connections are correct, replace the relay board.

The draft motor runs but the furnace does not light and the sparker does not spark.

1. The ignition control (IC1, IC2) may be locked out due to either a flame roll out or 100% shut off. These safety features are described above. If lock-out has occurred, 24V must be removed from the ignition controls. This is done at the unit or by resetting the room thermostat. After resetting 24V, check for proper furnace operation. If lock-out continues to occur, locate the source of the problem and correct.
2. Check all 24 volt connections from the relay board to and in the gas heat section. Check low voltage connections to the (ETD) located in the control box.
3. If the furnace is hot, it may be out on an over-temperature condition, wait for limit reset.
4. If the furnace is cold, check for 24 volts at wire 241 attached to the electrical time delay (ETD) located in the main control box. If 24 volts is not found, replace the ETD.
5. 24 volts is found at wire 241, remove the wires attached to the (TDR) and with a VOM, check for continuity across contacts 1 and 2. If none is found, the (TDR) is open and must be replaced. If there is continuity, re-attach the wires.With the draft motor running, check for 24 volts at terminal 4 of (RW1-2) and (RW2-1). If 24 volts is not present, the centrifugal switch (CS) has not closed or has gone bad. Check the line voltage to the unit - if it is correct, replace the draft motor. If line voltage is low, call the power company.
6. Check for 24V at terminal 2 of (RW1-2 and RW2-1). If 24V is not present, check for 24V at (RW1 and RW2) relay coils. If these relays are pulled in, then check for a loose connection at terminal 2 and terminal 4 of each relay. If no problem is found, then replace (RW1 and/or RW2) as required.
7. If 24 volts is present at the ignitor controls, check all control wiring at the ignitor controls and the high tension wire to the ignitors. Check that the ground wires from the ignitor controls, the gas valves and pilot burners are all intact and making good electrical connection. Check to make sure that the ceramic insulator on the pilot ignitors or sensors is not broken or cracked, if all are intact, replace the ignition control IC1 or IC2.

The draft motor runs and the ignitor sparks at the pilot burner but the pilot does not ignite and a gas odor is not detected at the draft motor outlet.

1. Check to make sure gas is being supplied to the unit. Make sure that the gas pressure to the unit is within the proper limits as described in the “POST START CHECK LIST” page 52 and that the pilot adjust screw is allowing some flow of gas as described in “PILOT CHECKOUT” page 54.
2. Check all wiring between the ignitor control and the gas valve. Check to make sure the ground connections are intact.
3. If the wiring is intact, check for 24 volts across terminals “PV” and “COMMON” on the ignitor control. If 24 volts is not present, replace the ignitor control.
4. If 24 volts is present, remove the pilot burner and remove the pilot orifice from the pilot burner. The orifice is removed in the direction opposite the flow of gas. Inspect the orifice for obstruction. If it is clear, replace the main gas valve.

The ignitor sparks at the pilot burner but the pilot does not ignite and a gas odor is detected at the draft motor outlet.

1. Adjust the pilot adjust screw on the gas valve as described in “PILOT CHECKOUT” page 54.
2. Check the supply pressure as described in “POST START CHECK LIST” page 52. Make adjustments as necessary.

3. Check the pilot orifice for obstruction as described in paragraph above. Clean as needed but the problem should not be the gas valve.

The pilot burner ignites but the ignitor continues to spark and the main burners do not ignite.

1. Make the same checks and adjustment as described in “PILOT CHECKOUT” page 54.
2. Check the supply pressure as described in “POST START CHECK LIST” page 52. Make adjustments as necessary.
3. Make sure that the pilot burner is not bent or damaged.
4. Make sure that the ground connections at the pilot burner, gas valve and ignitor control are intact. Check the high tension wire for good electrical connection. If all are intact, replace the ignitor module.

The pilot burner lights and the spark stops but the main burners do not light.

1. Check electrical connections between the ignitor control and the gas valve. If intact, check for 24 volts across terminals “MV” and “COMMON” terminals. If no voltage detected, replace ignitor control. If voltage is present, replace gas valve.

Furnace lights with roll-out or one burner has delayed ignition.

1. Make sure that the pilot burner is aligned properly with the carryover as described in “PILOT CHECKOUT” page 54.
2. Make sure that the carryovers on adjoining burners are screwed fast and are level with respect to one another.

Main burners light but exhibit erratic flame characteristics.

1. Adjust air shutters as described in “BURNER AIR SHUTTER ADJUSTMENT” page 54.
2. Check the main burner orifices for obstruction and alignment. Removal procedure is described in BURNER INSTRUCTIONS page 54. Clean or replace burner orifices and burners as needed.

Unit Control Board Flash Codes

Various flash codes are utilized by the unit control board (UCB) to aid in troubleshooting. Flash codes are distinguished by the short on and off cycle used (approximately 200ms on and 200ms off). To show normal operation, the control board flashes a 1 second on, 1 second off “heartbeat” during normal operation. This is to verify that the UCB is functioning correctly. Do not confuse this with an error flash code. To prevent confusion, a 1-flash, flash code is not used.

Alarm condition codes are flashed on the UCB lower left Red LED, See Figure 31. While the alarm code is being flashed, it will also be shown by the other LEDs: lit continuously while the alarm is being flashed. The total of the continuously lit LEDs equates to the number of flashes, and is shown in the table. Pressing and releasing the LAST ERROR button on the UCB can check the alarm history. The UCB will cycle through the last five (5) alarms, most recent to oldest, separating each alarm flash code by approximately 2 seconds. Flash code 21 is a non-alarm condition but due to the space constraints of the UCB, will be indicated by the Red LED. In all other cases, a flashing Green LED will be used to indicate non-alarm conditions.

In some cases, it may be necessary to “zero” the ASCD for the compressors in order to perform troubleshooting. To reset all ASCDs for one cycle, press and release the UCB TEST/ RESET button once.

Flash codes that do and do not represent alarms are listed in Table 25.

Table 25: Unit Control Board Flash Codes

Flash Codes	Description	Green LED 16	Red LED 8	Red LED 4	Red Led 2	Red LED 1
On Steady	This is a Control Failure	-	-	-	-	-
1 Flash	Not Applicable	-	-	-	-	-
2 Flashes	Control waiting ASCD[1]	Flashing	Off	Off	On	Off
3 Flashes	HPS1 Compressor Lockout	Off	Off	Off	On	On
4 Flashes	HPS2 Compressor Lockout	Off	Off	On	Off	Off
5 Flashes	LPS1 Compressor Lockout	Off	Off	On	Off	On
6 Flashes	LPS2 Compressor Lockout	Off	Off	On	On	Off
7 Flashes	FS1 Compressor Lockout	Off	Off	On	On	On
8 Flashes	FS2 Compressor Lockout	Off	On	Off	Off	Off
9 Flashes	Ignition Control Locked Out / Ignition Control Failure	Off	On	Off	Off	On
10 Flashes	Compressors Locked Out on Low Outdoor Air Temperature[1]	Flashing	On	Off	On	Off
11 Flashes	Compressors locked out because the Economizer is using free Cooling[1]	Flashing	On	Off	On	On
12 Flashes	Unit Locked Out due to Fan Overload Switch Failure	Off	On	On	Off	Off
13 Flashes	Compressor Held Off due to Low Voltage[1]	Flashing	On	On	Off	On
14 Flashes	EEPROM Storage Failure	Off	On	On	On	Off
15 Flashes	HPS3 Compressor Lockout	Off	On	On	On	On
16 Flashes	HPS4 Compressor Lockout	On	Off	Off	Off	Off
17 Flashes	LPS3 Compressor Lockout	On	Off	Off	Off	On
18 Flashes	LPS4 Compressor Lockout	On	Off	Off	On	Off
19 Flashes	FS3 Compressor Lockout	On	Off	Off	On	On
20 Flashes	FS4 Compressor Lockout	On	Off	On	Off	Off
21 Flashes	Compressor Off due to Low SAT[1]	On	Off	On	Off	On
OFF	No Power or Control Failure	Off	Off	Off	Off	Off

1. Non-alarm conditions.

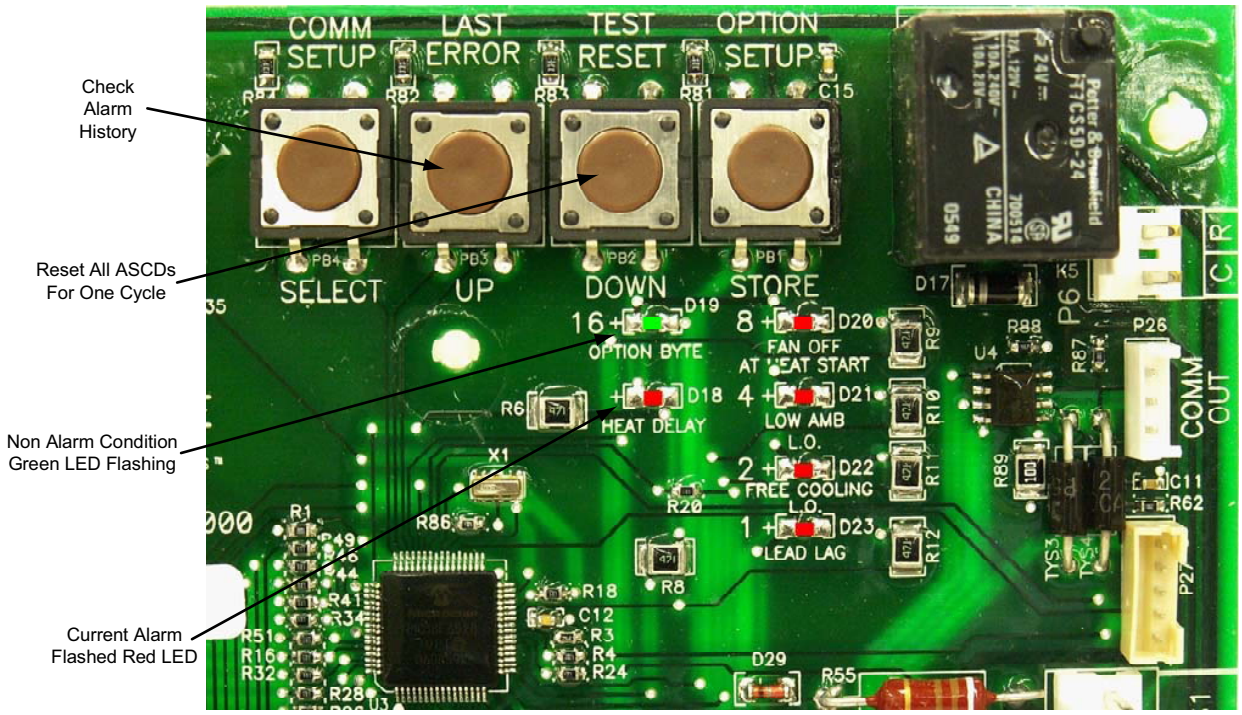


Figure 31: Unit Control Board

Unit Control Board Option Setup

Option Byte Setup

- Enter the Option Setup mode by pushing the OPTION SETUP / STORE button, and holding it for at least 2 seconds.
- The green status LED (Option Byte) will be turned on and the red status LED (Heat Delay) is turned off.
- The 8, 4, 2 and 1 LEDs will then show the status of the 4 labeled options (**(8) Fan Off at Heat Start**, **(4) Low Ambient Lockout**, **(2) Free Cooling Lockout**, and **(1) Lead / Lag)**.
- Press the UP or Down button to change the LED status to correspond to the desired Option Setup.
- To save the current displayed value, push the OPTION SETUP / STORE button and hold it for at least 2 seconds. When the value is saved, the green LED will flash a few times and then normal display will resume.

NOTE: While in either Setup mode, if no buttons are pushed for 60 seconds, the display will revert to its normal display, exiting the Option Setup mode. **When saving, the control board only saves the parameters for the currently displayed mode (Option Byte or Heat Delay).**

Heat Delay Setup

- Enter the Option Setup mode by pushing the OPTION SETUP / STORE button, and holding it for at least 2 seconds.
- The green status LED (Option Byte) will be turned on and the red status LED (Heat Delay) is turned off.
- Press the COMM SETUP / SELECT button to toggle into the Heat Delay Setup, the green LED will turn off and the red LED for Heat Delay will turn on.
- The 8, 4, 2 and 1 LEDs will then show the status of the Heat Delay, (See Table 26). Press the UP or Down button to change the LED status to correspond to the desired Heat Delay Value.
- To save the current displayed value, push the OPTION SETUP / STORE button and hold it for at least 2 seconds. When the value is saved, the red LED will flash a few times and then normal display will resume.

NOTE: While in either Setup mode, if no buttons are pushed for 60 seconds, the display will revert to its normal display, exiting the Option Setup mode. **When saving, the control board only saves the parameters for the currently displayed mode (Option Byte or Heat Delay).**

Table 26: Heat Delay

Heat Fan On Delay	Heat Fan Off Delay	Red LED 8	Red LED 4	Red LED 2	Red LED 1
60	180	On	On	On	On
60	90	On	On	On	Off
60	60	On	On	Off	On
60	30	On	On	Off	Off
45	180	On	Off	On	On
45	90	On	Off	On	Off
45	60	On	Off	Off	On
45	30	On	Off	Off	Off
30	180	Off	On	On	On
30	90	Off	On	On	Off
30	60	Off	On	Off	On
30	30	Off	On	Off	Off
0	60	Off	Off	On	On
0	30	Off	Off	On	Off
0	10	Off	Off	Off	On
Non-std	Non-std	Off	Off	Off	Off

Optional VAV Control Board Flash Codes

Flash codes are also utilized by the VAV add-on board to aid in troubleshooting optional VAV applications. Flash codes are displayed by a red LED located near the center of the board using a short on/off cycle (approximately 200-ms on and 200-ms off).

To verify that the board is functioning correctly, the LED will display a repetitive 1 second on, 1 second off "heartbeat". Do not confuse this "heartbeat" with the error flash codes shown in the table below. To prevent confusion, a 1-flash, flash code is not used.

Table 27: VAV Control Board Flash Codes

FLASH CODE	DESCRIPTION
On Steady	Control Failure
1 Flash	Not Applicable
2 Flashes	Loss of Communication with UCB
3 Flashes	Space Sensor Failure
4 Flashes	SAT Sensor Failure
5 Flashes	RAT Sensor Failure
6 Flashes	OAT Sensor Failure
7 Flashes	OH Sensor Failure
8 Flashes	RH Sensor Failure
9 Flashes	IAQ Sensor Failure
10 Flashes	OAQ Sensor Failure
11 Flashes	APS Sensor Failure
12 Flashes	Limit 2 Switch Open
13 Flashes	Purge
14 Flashes	VFD Input Failure
15 Flashes	Dirty Filter Switch
OFF	No Power or Control Failure

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860261-JIM-B-0612
Supersedes: 860261-JIM-A-0612

Johnson Controls Unitary Products
5005 York Drive
Norman, OK 73069

O&M SECTION SHEET

SECTION: 3
PRODUCT: EXHAUST FANS

Paulson-Cheek Mechanical, Inc.
6145 Norhtbelt Parkway, Suite F
Norcross, GA 30071

PHONE: 770-729-0076
FAX: 770-729-1076

PROJECT: **Pinewood Atlanta - Phase 1A**
Stage 9
LOCATION: **Fayetteville, GA**

Paulson-Cheek Mechanical, Inc.

ARCHITECT'S/ENGINEER'S STAMP

Paulson-Cheek Mechanical, Inc.

DATE RECEIVED:	06/12/14
MANUFACTURER:	PennBarry
SUPPLIER:	Georgia Air Associates
SUBMITTED DATE:	06/12/14

[X] NO ERRORS DETECTED

[ ] CORRECT EXCEPTIONS NOTED

THIS APPROVAL OF SHOP DRAWINGS DOES NOT RELIEVE THE SUBCONTRACTOR OR VENDOR FROM THE REQUIREMENTS OF THE CONTRACT DOCUMENTS.

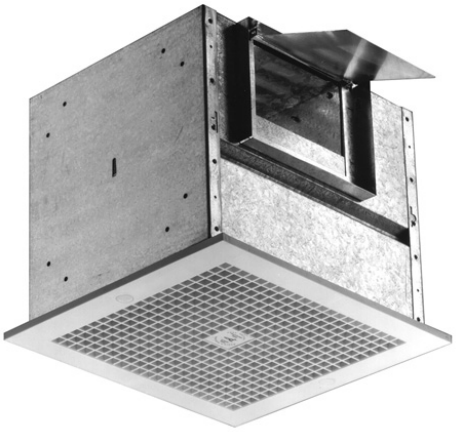
CHECKED BY:	William Hagler
DATE CHECKED:	06/12/14

PENN BARRY

PLEASE READ AND SAVE THESE INSTRUCTIONS.

Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage! Retain instructions for future reference.

Zephyr Ceiling & Inline Fans (Models Z3H Through Z12H)



PennBarry Ceiling Fans are quiet. They are designed for applications where a low noise, high reliability ceiling or cabinet fan is required. With air capacities from 30 to 1600 CFM, they're ideally suited for use in ventilating bathrooms or other low to medium CFM applications. Housings are fabricated of sturdy galvanized steel to ensure durability. Acoustic insulation, in combination with matched motor and wheel assemblies, lowers sound levels and improves air performance. Further, motors are mounted on vibration isolators to minimize noise levels. Together, these features ensure years of problem free, quiet operation.

Receiving and Handling

PennBarry fans are carefully inspected before leaving the factory. When the unit is received, inspect the carton for any signs of tampering. Inspect the unit for any damage that may have occurred during transit and check for loose, missing or damaged parts. Mishandled units can void the warranty provisions. PennBarry is not responsible for damages incurred during shipment.

Avoid severe jarring and/or dropping. Handle units with care to prevent damage to components or special finishes.

Storage

Long-term storage requires special attention. Units should be stored on a level, solid surface, preferably indoors. If outside storage is necessary, protect the units against moisture and dirt by encasing the cartons in plastic or some similar weatherproof material.

Unpacking

Place carton in an upright position and remove staples or use a sharp (knife edge) tool to CAREFULLY cut or scribe the sealing tape on both sides at the top of the carton. Open carton flaps. Remove any cardboard and wooden filler pieces, as well as loose components or accessories shipped with the unit.

Carefully remove the unit from the carton. Inspect the unit for any damage that may have occurred during transit and check for loose, missing or damaged parts.

Installation

⚠ CAUTION ***For general ventilating use only, do not use to exhaust hazardous or explosive materials and vapors.***

Remove internal protective shipping trays and fillers. Check for and remove any loose hardware or particles from the inside of the fan housing. Disconnect motor cord and plug from internal terminal box and receptacle. On installations made before a final ceiling is installed, with access from below, the following procedure applies. Assemble adjustable flanges to fan housing with four self-tapping metal screws provided. The adjustable flanges should be located as illustrated in Figure 1.

Note: standard Zephyrs are set up for RA (right angle discharge). For TD (top discharge) or TDA (Inline) see conversion instructions.

Note: On model Z6S / H, when using a variable speed controller, wire to high (h) setting only.

Use appropriate hardware (i.e., wood screws or sheet metal screws, depending on joist construction), secure the adjustable flanges to each joist. Attach a properly sized duct to duct sleeve mounted on the fan housing. Run this duct system to an appropriate wall or roof cap. **Discharge side must be guarded, unless it is connected to duct.**

Figure 1

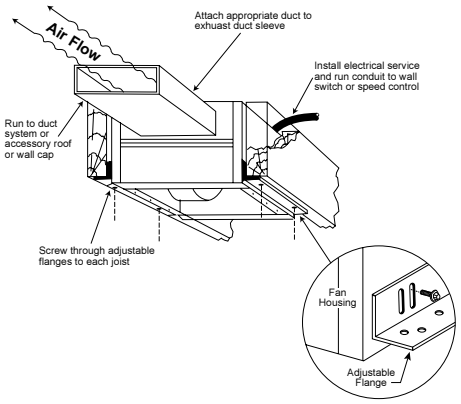

Air Flow
Attach appropriate duct to exhuast duct sleeve
Install electrical service and run conduit to wall switch or speed control
Run to duct system or accessory roof or wall cap
Screw through adjustable flanges to each joist
Fan Housing
Adjustable Flange

Figure 2

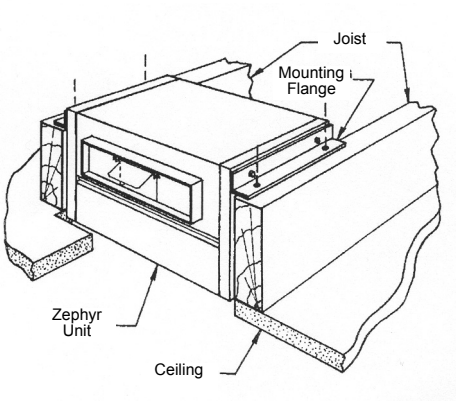
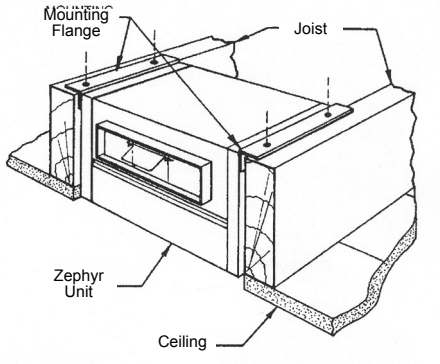


Figure 2a



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PART #59575-0

Normally, power is brought up from within the building through conduit lines and located at the terminal box. Before wiring is attempted, always lock out primary and secondary power source. Utilizing the pre-punched hole found at the terminal box on the fan housing, insert a 3/8" electrical connector. All wiring furnished should be in strict accordance with the National Electrical Code and local, state and federal standards. Complete the installation by cutting a 9 1/2" by 12 1/2" ceiling opening for the Z3, Z5 and Z6; 11 7/8" by 13 3/4" for the Z8 and Z81; 14 1/2" by 18" for the Z10; and 14 1/2" by 23 3/4" for Z101, Z102, Z12 and Z121 ceiling fan.

Installation of ceiling fans in suspended ceiling systems require a minimum 10 gauge solid wire for hanging or suspending the ceiling fan. Four wires per unit should be connected to the pre-punched holes of the adjustable mounting flanges (after the flanges have been mounted to the fan housing as outlined above). Note: For the Z12 and Z121, 1/4" threaded rods or perforated steel strips should be used per fan as illustrated in Figure 4.

If installation is to be made with ceiling in place, access must be from above. The following procedure should be used for installing the Zephyr Ceiling Fans. Assemble the adjustable flanges to the fan housing as illustrated in Figures 2 or 2A. Position adjustable flanges so the unit is flush with top side of ceiling surface. Tighten the adjustable flanges and secure them with the appropriate hardware (wood screws or sheet metal screws, depending on framing construction). Use the housing as a template, punch or drill a small hole through the ceiling at each corner of the housing and cut an opening in the ceiling, using these holes as a guide. Install the duct and electrical service in accordance with the instructions listed in the previous section.

Figure 5a

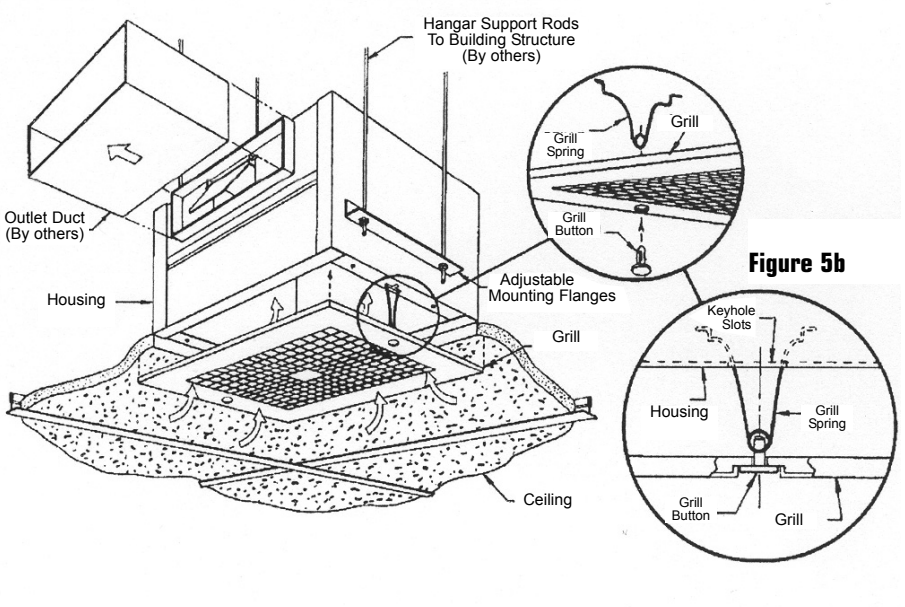


Figure 5b

In installations where the ceiling is already installed and there is no access from above, the following procedure should be followed. Before cutting ceiling opening, determine the exact location of framing or support members. Cut hole in ceiling using care not to exceed the dimensions of the ceiling grille. Note: The ceiling hole should be cut so that one edge of the hole is in line with the inside face of the joist. The hole must be large enough to permit passage of the fan housing into the ceiling space. Care should be taken not to exceed the ceiling grill dimensions when cutting.

Remove the blower assembly from the housing. For single blower units, remove two #10 sheet metal screws near the blower, slide power pack to the left to release it from the housing. (For double blower units, remove one 1/4" bolt).

Electrical service should now be brought up to the fan location. This should be done in accordance with the instructions listed in the previous section.

To secure housing in ceiling space, raise the housing into place with one edge of the housing against joist “A” (see Figure 3). Determine if it is necessary to build out from joist “B” so that the housing can be secured from both sides. If building out is necessary, an appropriate piece(s) of wood should be utilized. These wood spacers should be nailed to joist “B” to increase the thickness of the joist at the point where the fan will be installed. The fan housing should fit snugly between joist “A” and joist “B” (or the built-out-section of joist “B”). If spacers are required for joist “B”, they should be sized according to the dimension of the fan housing. Using care to avoid damage to the housing, secure the housing to the joists by nailing through the pre-punched holes found at the top and bottom of housing sides. These pre-punched holes would normally be utilized as a point of attachment for the adjustable flanges; however, these flanges will not be necessary with this type of installation.

Figure 3

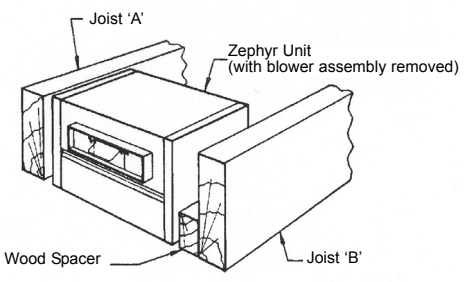
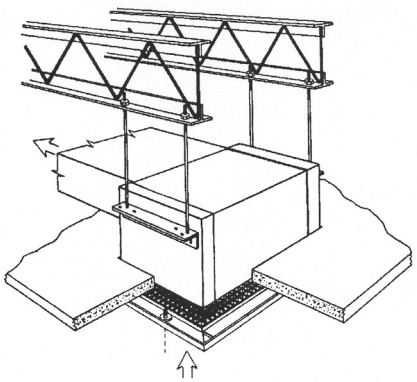


Figure 4



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Before the nails are driven snug, care should be taken to assure that the housing is 1/4" above the ceiling level. Nails should now be secured. Care should be taken to assure that the nail head is large enough to prevent slipping through the pre-punched holes. A washer can be used to increase the bearing surface. Re-attach blower assembly to housing. Lock out primary and secondary power source and secure electrical lines to the terminal box. This should be done in accordance with the procedure outlined.

For all of the installation situations described above, the egg crate ceiling grill should be installed as a final step. This is done by first assembling the two torsion springs to the grill. Use the torsion springs and grill buttons from the hardware kit provided. Insert the grille buttons into the ceiling grill as shown in Figure 5a through the slot in the grill buttons. The grill is now ready for assembly to the housing. Lift the grill into position below the housing. Insert the two torsion springs into the keyhole slots located in the center of the housing as shown in Figure 5B. Push the grill towards the housing.

Electrical Connections

⚠ CAUTION ***Before attempting any repair or installation work, be certain that all power to the motor and electrical accessories are turned off and locked in off position.***

1. Connect Motor per nameplate to correct power supply.
2. Install all wiring, protection and grounding in accordance with national electrical code and local requirements.
3. Follow all local electrical and safety codes, as well as the National Electrical Code (NEC) and the Occupational Safety and Health Act (OSHA).
4. In order to prevent motor failure when speed controller is used unit must be started on high speed before turning to low speed.

⚠ CAUTION **** For low speed insulate black lead as shown on Figure 7.***

⚠ CAUTION ***** For high speed insulate red lead and connect black to black with wire nut.***

Note: On Model Z6S / H, when using a variable speed control, wire to the high (H) setting only.

Make all of the necessary connections by using two wire nuts. A Separate ground wire must be connected to the grounding screw. Reinstall the cover of the junction box.

Maintenance

⚠ CAUTION ***To reduce the risk of injury, disconnect from power supply before servicing.***

The blower wheel, housing and grille should be cleaned of dust and grease if required. Power should be disconnected before cleaning the internal parts of the ceiling fan.

Remove the grill. Use a vacuum cleaner with the appropriate attachments and vacuum dust from the grill. Wash the grill with a warm, soapy solution of water. Allow grill to air dry thoroughly before reinstalling.

To clean blower wheel(s) and housing, unplug blower from integral terminal box. Remove the blower assembly from the housing. For single blower units, remove two #10 sheet metal screws near the blower discharge and slide to the left. For double blower units, remove one 1/4" bolt next to motor. Vacuum blower wheel, if necessary, the wheel can be washed. Use extreme caution – do not allow water to enter motor. Wipe blower wheel dry with an absorbent cloth. Before replacing blower / motor assembly, wipe out interior of housing. Replace blower/motor assembly and secure with self-tapping screws. Plug in blower motor to terminal box.

Figure 6: Internal Electrical Connections, Single Speed Motors

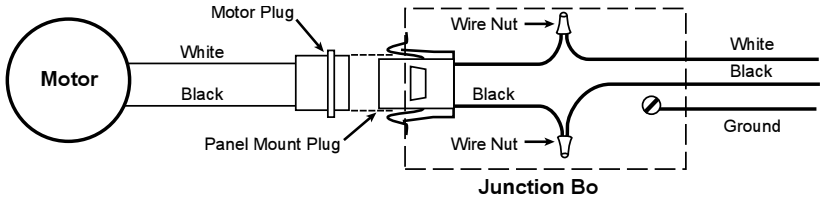


Figure 7: Internal Electrical Connections, Two Speed Motors

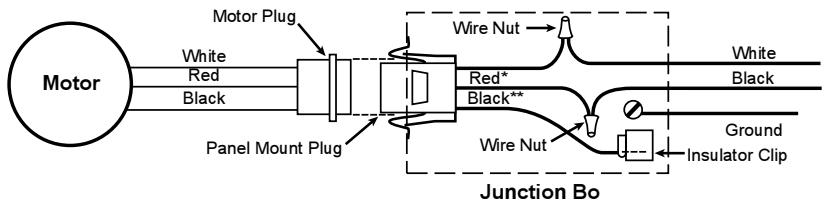
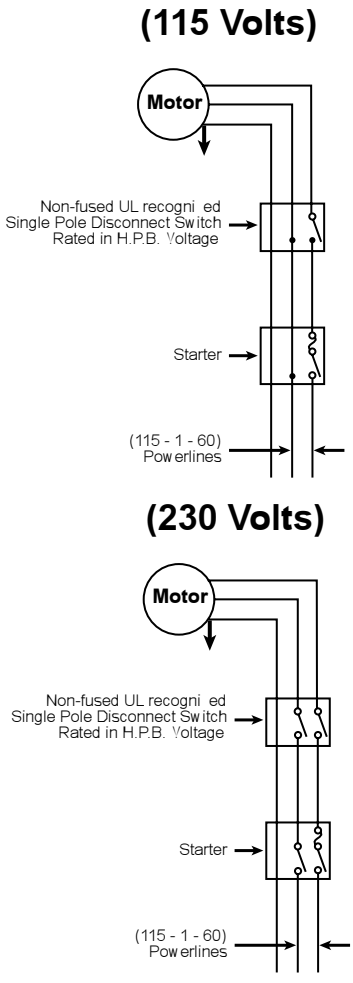


Figure 8: External Electrical Connections



Note: All motors are checked prior to shipment; however, if motor defects should develop, prompt service can be obtained from the nearest authorized service station of the motor manufacturer while under warranty. Exchange, repair or replacement will be provided on a no charge basis if the motor is defective within the warranty period. The PennBarry representative in your area will provide a name and address of an authorized service station if requested. Do not return defective motors to Pennbarry. WARNING: Motor guarantee is void unless overload protection is provided in motor wiring circuit.

Hidden Danger

In addition to the normal dangers of rotating machinery, fans present an additional hazard in their ability to suck in not only air, but loose materials as well. Solid objects can pass through the fan and be discharged by the impeller as potentially dangerous projectiles.

Intake to duct work should, whenever possible, be screened to prevent the accidental entrance of solid objects. Access doors or grill to a duct system should never be opened with the fan running.

When a fan is being started for the first time, a complete inspection of the duct work and interior of the fan should be made (with the power locked off) to make certain there is no foreign material which can be sucked into or blown through the duct work.

Fan Guards

All fans have moving parts which require guarding in the same way as other moving machinery. In areas which are accessible only to experienced personnel, a standard industrial type guard may be adequate. This type of guard will prevent the entry of thrown or dropped objects with a minimum restriction of air flow.

Where the fan is accessible to untrained personnel or the general public, maximum safety guards should be used, even at the cost of some loss of performance.

⚠CAUTION ***To reduce the risk of injury of a person, install the fan at least 7 feet above the floor if no guard is installed.***

Roof-mounted equipment will require guards when access is possible, for example, by climbing children.

Centrifugal fans may be connected directly to duct work which will prevent contact with the internal moving parts, but when the inlet or outlet is exposed, a suitable guard should be installed.

Do not install in cooking or shower stall area (see Figure 23).

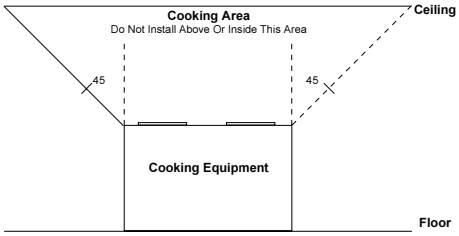
⚠CAUTION ***Units are designed to handle clean are only. Avoid installation in corrosive and dusty environments.***

⚠WARNING ***To reduce the risk of fire, electric shock or injury to persons, observe the following:***

A. Use this unit only in the manner intended by the manufacturer, if you have questions, contact the manufacturer.

B. Before servicing or cleaning unit, switch power OFF at service panel and lock the service panel to prevent power from being switched ON accidentally. When the service disconnecting means cannot be locked, securely fasten a prominent warning device, such as a tag, to the service panel.

Figure 23



⚠WARNING ***To reduce the risk of fire, electric shock or injury to persons, observe the following:***

A. Installation work and electrical wiring must be done by qualified person(s) in accordance with all applicable codes and standards, including fire-rated construction.

B. Sufficient air is needed for proper combustion and exhausting of gases through the flue (chimney) of fuel burning equipment to prevent back drafting. Follow the heating equipment manufacturer's guideline and safety standards such as those published by the National Fire Protection Association (NFPA), the American Society for Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) and local code authorities.

C. When cutting or drilling into wall or ceiling, do not damage electrical wiring and other hidden utilities.

D. Ducted fans must always be vented to the outdoors.

E. If this unit is to be installed over a tub or shower, it must be marked as appropriate for the application.

F. NEVER place a switch where it can be reached from a tub or shower.

⚠CAUTION ***For general ventilating use only. Do not use to exhaust hazardous or explosive materials and vapors.***

Use caution when handling sheet metal products. Protection should be used to avoid contact with sharp edges or injury may occur.

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Table 1: Accessories Matrix

Model	Roof Caps			Wall Cap	Brick Vent	Switches		Radiation‡ Damper	Metal Face Grill
	Flat	Curb Mnt.	Slope			Speed Ctrl.	Time Delay		
Z3H	WCF06	WCC06	SL20+	WC10	B68	LT30	AM12	DDA3	MFG6
Z5H	WCF06	WCC06	SL20+	WC10	B68	LT30	AM12	DDA3	MFG6
Z6S/H	WCF06	WCC06	SL20+	WC10	B68	LT30**	AM12	DDA3	MFG6
Z8S/H	WCF08	WCC08	SL20+	WC10	B68	LT30	AM12	DDA8	MFG8
Z81S	WCF08	WCC08	SL20+	WC10	B68	LT30	AM12	DDA8	MFG8
Z10S/H	WCF08	WCC08	SL20+	SL20+	B100	LT50	AM12	DDA10	MFG10
Z101S	WCF10	WCC10	WCF10†	***	B120	LT30	AM12	DDA12	MFG12
Z102S	WCF10	WCC10	WCF10†	***	B120	LT50	AM12	DDA12	MFG12
Z12S	WCF12	WCC12	WCF12†	***	B120	LT50	AM12	DDA12	MFG12
Z121S	WCF12	WCC12	WCF12†	***	B120	LT50	AM12	DDA12	MFG12
Z102H	WCF14	WCC14	WCF14†	***	B120	LT40	AM12	DDA12	MFG12
Z12H	WCF14	WCC14	WCF14†	***	B120	LT40	AM12	DDA12	MFG12
Z14	WCF20	WCC20	CF	***	B120	LT40	AM12	–	MFG14
Z15	WCF20	WCC20	CF	***	B150	LT35	–	–	MFG15

+ Manufactured of galvanized steel. All other accessories manufactured of aluminum.
‡ Kit is field installed, shipped separate from fan.
** Z6H unit only. ***Use brick vent. †4 in 12 max. pitch.

Table 2: Roof Caps

Model	A (Throat) Dia	B	C	E Sq	F	H	L Dia	* Damper Sq
WCF06	7	N/A	3 1/2	16 7/8	8	11 1/2	12	NA
WCF08	9	N/A	5 1/2	21 1/4	8	13 1/2	18 1/2	NA
WCF10	11	N/A	5 1/2	21 1/4	10	15 1/2	21	NA
WCF12	13	N/A	7	24	10	17	25	NA
WCF14	15	N/A	7	28	10	17	28	NA
WCF20	21	N/A	10 1/2	32	12	22 1/2	37	NA
WCC06	7	1	3 1/2	15	4	8 1/2	12	8 3/4
WCC08	9	1 1/2	5 1/2	18 1/2	4	11	18 1/2	11 1/4
WCC10	11	1 1/2	5 1/2	18 1/2	4	11	21	11 1/4
WCC12	13	2	7	20 1/2	4	13	25	15 3/4
WCC14	15	2	7	24 3/4	4	13	28	15 3/4
WCC20	21	2	101/2	28 1/2	5 1/2	18	37	19 3/4

Figure 13: Weather Caps

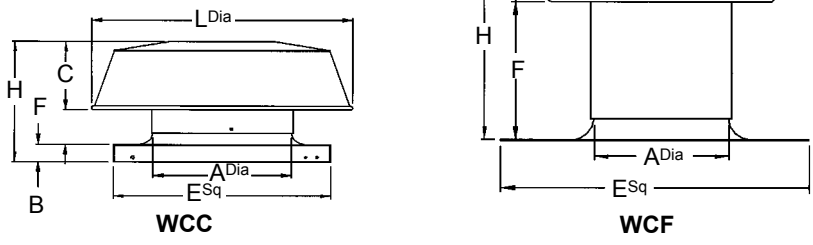


Figure 9: Roof Caps (Models SL20 and WC10)

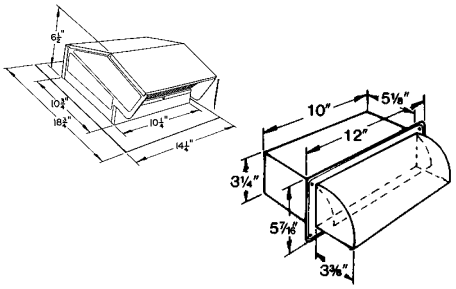


Figure 10: Duct Transitions

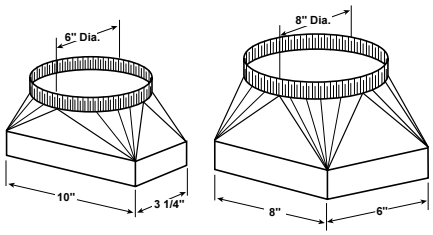
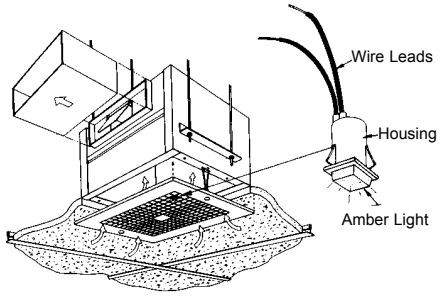


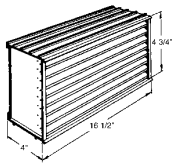
Figure 11: Pilot Light

Mounts in Grill Grid

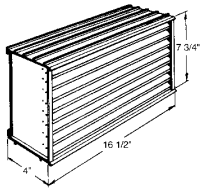


* See instructions included with Pilot Light Kit for proper wiring and installation.

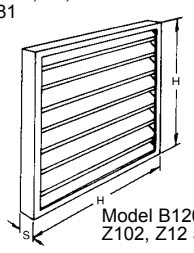
Figure 12: Brick Vents



Model B68 for Z3, Z5, Z6, Z8 and Z81



Model B100 for Z10



Model B120 for Z101, Z102, Z12 and Z121

Table 3: Dimensional Data

Model	Housing							Outlet Duct			Grill		TDA Intake Duct		
	A	B	C	D	E	E[1]	F	G	H	J	K	L	X	Y	Z
Z3H,Z5H,Z6S/H	12 1/2	9 1/8	16	9 1/8	1 1/4	1 1/4	5 3/8	10	3 1/4	3/4	11	13 3/4	10	6	1 5/8
Z8S/H,Z81S	13 7/8	11 3/8	17 3/8	11 3/8	1 7/8	4	5 1/4	8	6	3/4	13 1/4	14 7/8	10	8	1 9/16
Z10S/H	18	14 1/8	21 1/2	14 1/8	3 5/8	6 3/8	8	8	6	3/4	15 1/2	19 3/8	14	10	2
Z101S,Z102S/H, Z12S/H,Z121S	24	14 1/8	27 1/2	14 1/8	1	1	8	22	6	3/4	15 1/2	25	20	10	2

Figure 15: Models Z3H, Z5H and Z6S/H

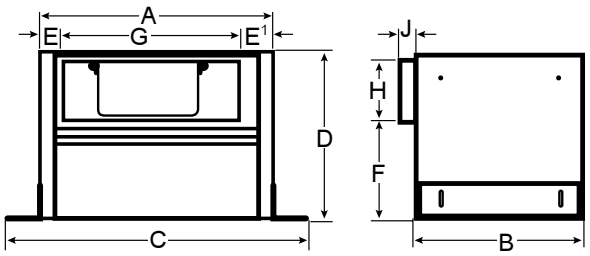


Figure 16: Models Z8S/H AND Z81S

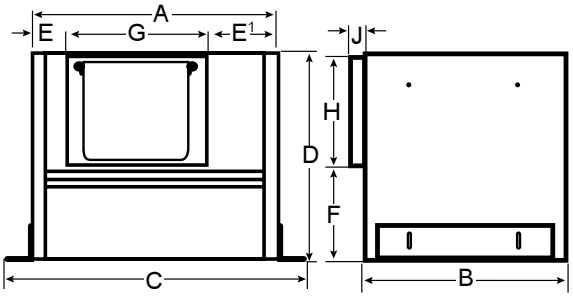


Figure 17: Model Z10S/H

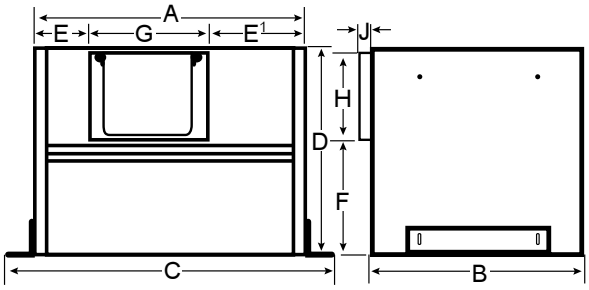


Figure 18: Models Z101S, Z102S/H, Z12S/H AND Z121S

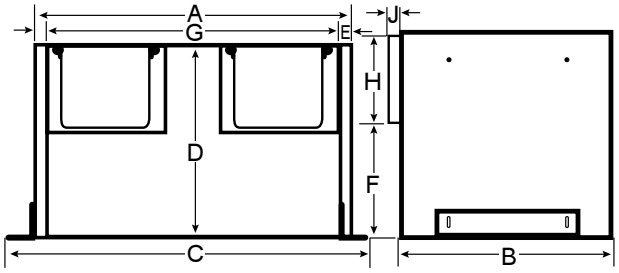


Figure 19

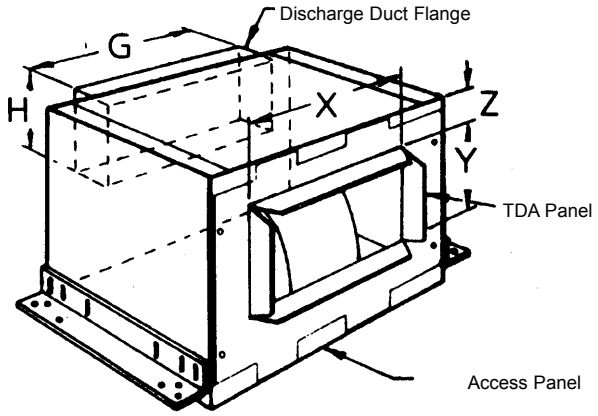
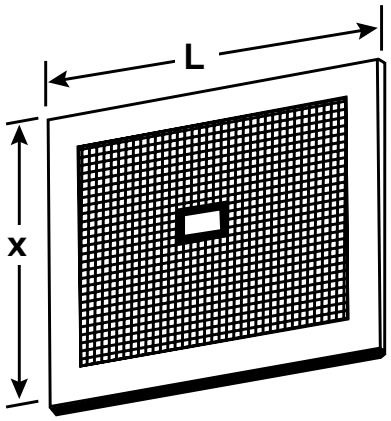


Figure 20



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Typical Exploded Views

Figure 21: Models Z3H, 5H, 6S/H, 8S/H, 81S and 10S/H

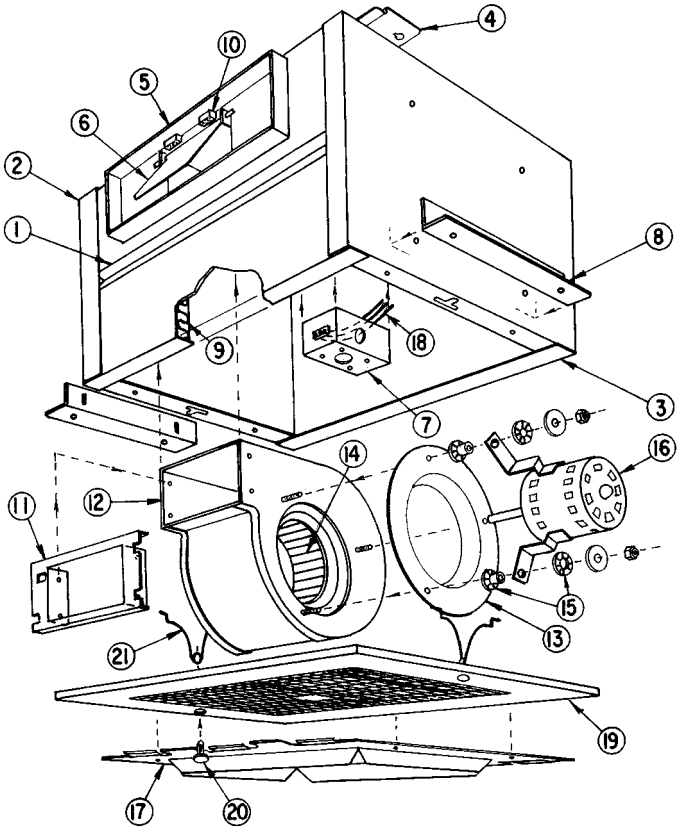
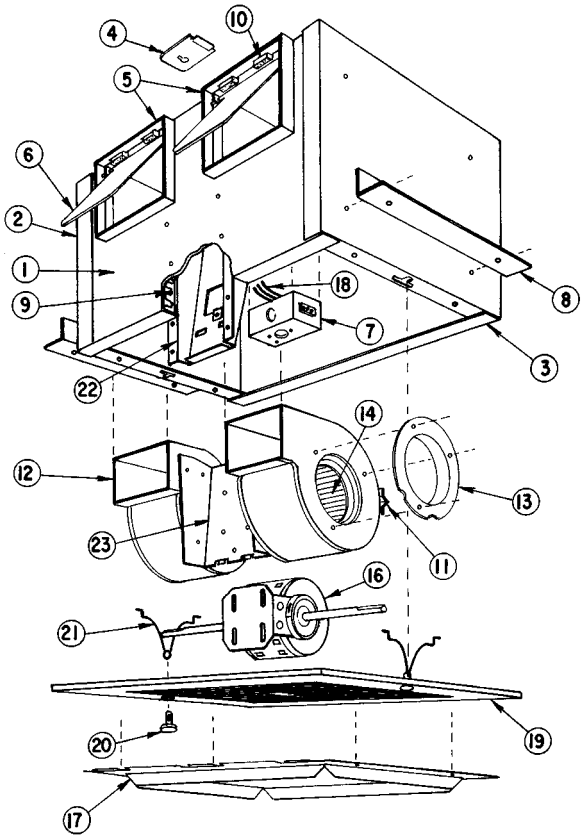


Figure 22: Models Z101S, 102S/H, 12S/H and 121S



Legend

1. Housing
2. End
3. Access Panel
4. Wiring Box Cover Plate
5. Duct Flange
6. Damper Blade
7. Junction Box
8. Housing Bracket
9. Insulation; Parts A, B, & C
10. Damper Stop
11. Blower Bracket
12. Blower Housing Assembly
13. Inlet
14. Wheel
15. Grommets, 2 Part : Male & Female (single blower units only)
16. Motor (115/1/60)
17. TDA Panel (Blank Off Plate) (not shown)
18. Wiring Assembly (2 & 3 Lead Versions) 3M Connector
19. Grill
20. Grill Button
21. Grill Spring
22. Box Brace (double blower units only)
23. Motor Plate (double blower units only)

Parts Replacement

If replacing parts, do so with properly selected components which duplicate the original parts correctly. Incorrectly sized parts can damage the fan.

Conversion Instructions
Models: Z3H, Z5H, Z5S/H, Z8S/H, Z81S & Z10S/H

RA / TD Ceiling Fan Conversions

RIGHT ANGLE (RA) TO TOP DISCHARGE (TD) CONVERSION

Note: As a standard, Zephyr RA / TD's are furnished with a Right Angle (RA) discharge as shown in Figure 24.

1. Disassemble the access panel from the housing by removing the two #10 sheet metal screws and then removing the panel by pulling it towards the housing opening as shown in figure 24.

Figure 24: "RA" (Right Angle)

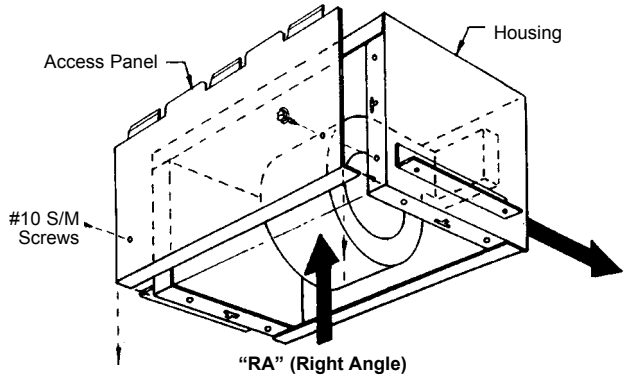
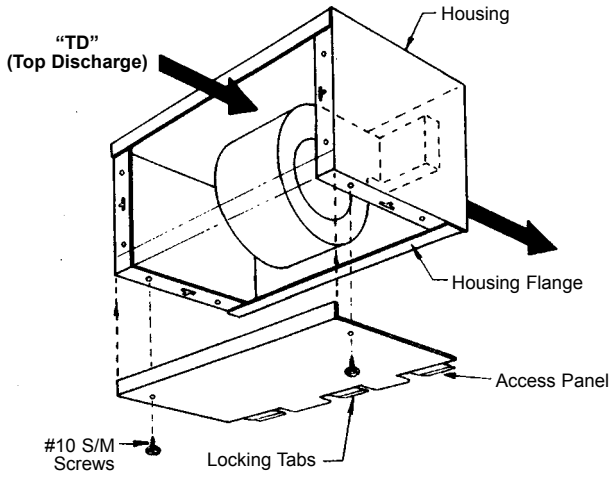


Figure 25: "TD" (Top Discharge)



2. Reassemble the access panel by rotating the access panel 90º and remount it to the housing. Slide in the 3 locking tabes to the housing flange and reinstall the two #10 sheet metal screws. See figure 25.

TDA In-line Fan Conversions

TDA IN-LINE TO RIGHT ANGLE DISCHARGE CONVERSION

Note: As a standard, Zephyr TDA's are furnished with an In-line discharge as shown in Figure 26.

1. Disassemble the TDA panel from the housing by removing the four #10 sheet metal screws. Remove both panels as shown in figure 26.

Figure 26: "TDA" (In-Line)

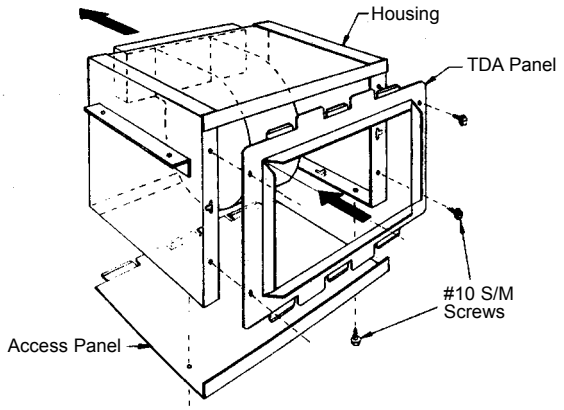
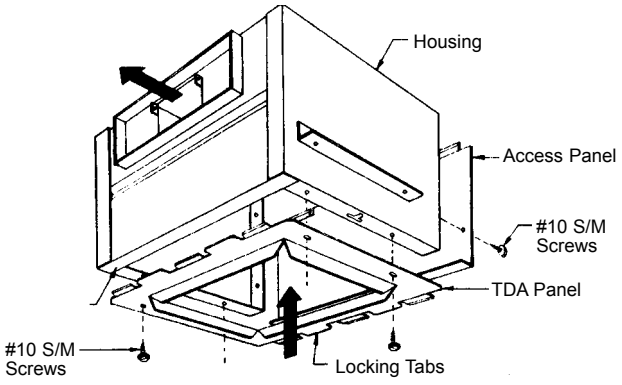


Figure 27: "TDA" (Right Angle)



2. Reassemble both the TDA and access panels after exchanging locations. First, slide the 3 locking tabs of the TDA panel into the housing flange. Second, slide the 3 tabs of the access panel into the housing. Third, engage the access panel return flange into the 3 locking tabs on the TDA panel. Finally, reinstall the six #10 sheet metal screws. See figure 27.

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Conversion Instructions
Models: Z101S, Z102S, Z12S, Z102H & Z12H

RA / TD Ceiling Fan Conversions

Right Angle (RA) To Top Discharge (TD) Conversion

Note: As a standard, Zephyr RA / TD's are furnished with a Right Angle (RA) discharge as shown in Figure 28.

1. Disassemble the access panel from the housing by first removing the four #10 sheet metal screws and then removing the panel as shown in figure 28.

Figure 28: "RA" (Right Angle)

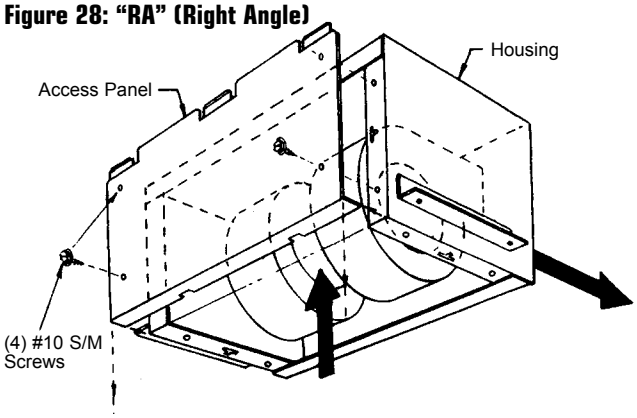
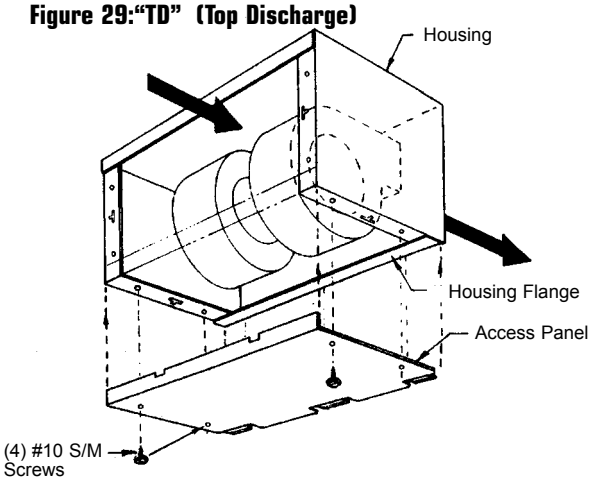


Figure 29:"TD" (Top Discharge)



2. Reassemble the access panel by rotating the access panel 90º and remount it to the housing. Finally, reinstall the four #10 sheet metal screws. See figure 29.

TDA In-line Fan Conversions

TDA IN-LINE TO RIGHT ANGLE DISCHARGE CONVERSION

Note: As a standard, Zephyr TDA's are furnished with an In-line discharge as shown in Figure 30.

1. Disassemble the TDA panel from the housing by removing the four #10 sheet metal screws securing the TDA panel to the housing and then remove the access panel by removing the four #10 sheet metal screws. Remove both panels as shown in figure 30.

Figure 30: "TDA" (In-Line)

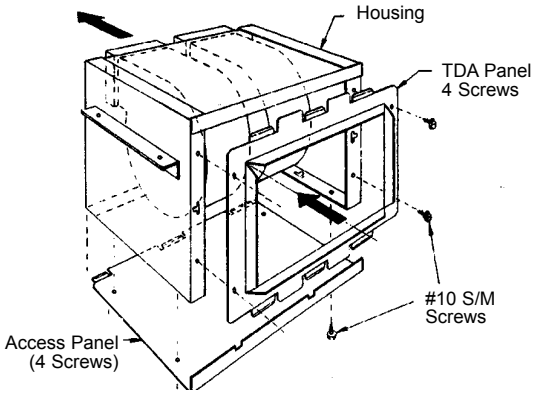
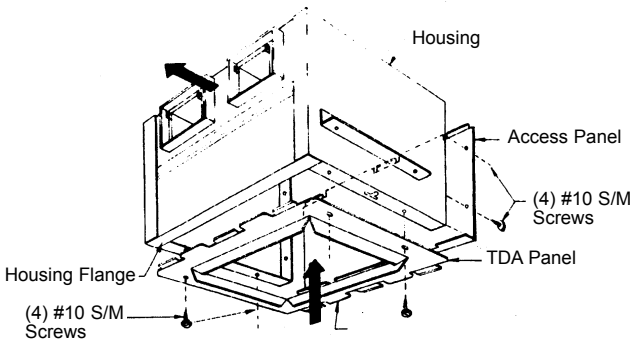


Figure 31: "TDA" (Right Angle)



2. Reassemble both the TDA and access panels after exchanging locations. First, slide the 3 locking tabs of the TDA panel into the housing flange. Second, engage the access panel return flange into the 3 locking tabs on the TDA panel. Finally, reinstall the eight #10 sheet metal screws. See figure 31.

Troubleshooting Checklist

Symptom	Possible Cause(s)	Corrective Action
Excessive noise	1. Defective or loose motor bearings	1. Replace motor with same frame size, RPM, HP
	2. Ventilator base not securely anchored	2. Reset properly
	3. Loose or unbalanced wheel/propeller	3. Tighten screws, remove build-up, balance wheel/propeller
	4. Misaligned pulleys or shaft	4. correct alignment
	5. Loose or damaged wheel/propeller	4. Replace wheel/propeller
	6. Wheel running in wrong direction	6. Reverse direction
Fan inoperative	1. Blown fuse or open circuit breaker	1. Replace fuses or circuit breaker
	2. Loose or disconnected wiring	2. Shut off power and check wiring for proper connections
	3. Defective motor	3. Repair or replace motor
	4. Broken belts	4. Replace belts
Insufficient airflow	1. Open access doors or loose sections of ducts	1. Check for leakage
	2. Clogged filters	2. Clean filters
	3. Operation in wrong direction	3. Correct rotation of wheel/propeller
	4. Insufficient make-up air direction	4. Add make-up fan or louver opening
Water leaking into ductwork or collection of grease under fan	1. Fan installed with slope in the wrong direction	1. Slope should be fitted in the direction of the drainage opening or grease collection box and drain spout
	2. Clogged drain spout	2. Clean drain spout
	3. Cooling tube or motor dome top removed	3. Install new cooling tube with gasket and dome top
	4. Grease container full	4. Empty grease box
Motor overheating	1. Belt slippage	1. Adjust tension or replace bad belts
	2. Overvoltage or under voltage	2. Contact power supply company
	3. Operation in wrong direction	3. Reverse direction of motor
	4. Fan speed too high	4. Slow down fan by opening variable pitch pulley on motor shaft
	5. Incorrect motor (service factor 1.0, low ambient temperature)	5. Replace motor with correct open, NEMA service factors (1.15 or higher) with 40 degrees ambient
	6. Blocked cooling tube or leaky gasket	6. Remove blockage and seal cooling tube in place
	7. Insufficient airflow to kitchen hood fan operating on low speed with kitchen in full operation	7. Check airflow under hood and adjust kitchen equipment output
	8. Undersized motor	8. Check motor ratings with catalog speed and air capacity chart

Note: Care should be taken to follow all local electrical, safety and building codes. Provisions of the National Electric Code (NEC), as wells as the Occupational Safety and Health Act (OSHA) should be followed.

All motors are checked prior to shipment. If motor defects should develop, prompt service can be obtained from the nearest authorized service station of the motor manufacturer while under warranty. Exchange, repair or replacement will be provided on a no charge basis if the motor is defective within the warranty period. The PennBarry representative in your area will provide a name and address of an authorized service station if requested. WARNING: Motor guarantee is void unless overload protection is provided in motor wiring circuit.

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Notes:

Limited Warranty

What Products Are Covered

PennBarry Fans and Ventilators (each, a "PennBarry Product")

One Year Limited Warranty For PennBarry Products

PennBarry warrants to the original commercial purchaser that the PennBarry Products will be free from defects in material and workmanship for a period of one (1) year from the date of shipment.

Exclusive Remedy

PennBarry will, at its option, repair or replace (without removal or installation) the affected components of any defective PennBarry Product; repair or replace (without removal or installation) the entire defective PennBarry Product; or refund the invoice price of the PennBarry Product. In all cases, a reasonable time period must be allowed for warranty repairs to be completed.

What You Must Do

In order to make a claim under these warranties:

1. You must be the original commercial purchaser of the PennBarry Product.
2. You must promptly notify us, within the warranty period, of any defect and provide us with any substantiation that we may reasonably request.
3. The PennBarry Product must have been installed and maintained in accordance with good industry practice and any specific PennBarry recommendations.

Exclusions

These warranties do not cover defects caused by:

1. Improper design or operation of the system into which the PennBarry Product is incorporated.
2. Improper installation.
3. Accident, abuse or misuse.
4. Unreasonable use (including any use for non-commercial purposes, failure to provide reasonable and necessary maintenance as specified by PennBarry, misapplication and operation in excess of stated performance characteristics).
5. Components not manufactured by PennBarry.

Limitations

1. In all cases, PennBarry reserves the right to fully satisfy its obligations under the Limited Warranties by refunding the invoice price of the defective PennBarry Product (or, if the PennBarry Product has been discontinued, of the most nearly comparable current product).
2. PennBarry reserves the right to furnish a substitute or replacement component or product in the event a PennBarry Product or any component of the product is discontinued or otherwise unavailable.
3. PennBarry's only obligation with respect to components not manufactured by PennBarry shall be to pass through the warranty made by the manufacturer of the defective component.

General

The foregoing warranties are exclusive and in lieu of all other warranties except that of title, whether written, oral or implied, in fact or in law (including any warranty of merchantability or fitness for a particular purpose).

PennBarry hereby disclaims any liability for special, punitive, indirect, incidental or consequential damages, including without limitation lost profits or revenues, loss of use of equipment, cost of capital, cost of substitute products, facilities or services, downtime, shutdown or slowdown costs.

The remedies of the original commercial purchaser set forth herein are exclusive and the liability of PennBarry with respect to the PennBarry Products, whether in contract, tort, warranty, strict liability or other legal theory shall not exceed the invoice price charged by PennBarry to its customer for the affected PennBarry Product at the time the claim is made.

Inquiries regarding these warranties should be sent to: PennBarry, 1401 North Plano Road, Richardson, TX 75081.

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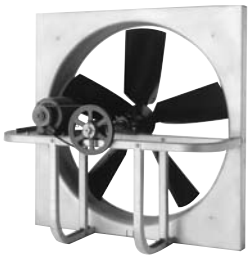
PENN BARRY

Please read and save these instructions. *Read carefully before attempting to assemble, install, operate or maintain the product described. Protect yourself and others by observing all safety information. Failure to comply with instructions could result in personal injury and/or property damage! Retain instructions for future reference.*

Breezeway Panel Fans: Direct & Belt Drive



Type BHM/BHH

TYPE BCH

TYPE BLL

TYPE P

TYPE BC

Receiving and Handling

PennBarry fans are carefully inspected before leaving the factory. When the unit is received, inspect for any signs of tampering. Inspect the unit for any damage that may have occurred during transit and check for loose, missing or damaged parts. Mishandled units can void the warranty provisions. If units are damaged in transit, it is the responsibility of the receiver to make all claims against the carrier. PennBarry is not responsible for damages incurred during shipment.

Avoid severe jarring and/or dropping. Handle units with care to prevent damage to components or finishes. If the unit is scratched due to mishandling, the protective coating may be damaged. Incorrect lifting may damage the fan and void the warranty.

Storage

Long-term storage requires special attention. Store units on a level, solid surface, preferably indoors. If outside storage is necessary, protect the units against moisture and dirt by encasing in plastic or in some similar weatherproof material. Periodically inspect units and rotate wheels to spread bearing lubricant. Failure to rotate wheels results in reduced bearing life and may void the manufacturer's warranty. If the unit will be stored for an extended time, remove belts. Belts that remain under tension in a stationary position for extended periods are likely to have a reduced operating life.

Installation

Any accessories which have been provided "knocked-down" can be assembled per illustrations provided (pages 6 - 9).

LOCATION AND GUARDS

All fans have moving parts which require guarding in the same way as other moving machinery. Where the fan is accessible to untrained personnel or the general public, use maximum safety guards, even at the cost of some performance. Unprotected fans located less than 7' above the floor require guarding as specified in the Occupational Safety and Health Act (OSHA). UL listed fans, to maintain their personal safety listing, must be installed not less than 10 feet above the floor. PennBarry recommends the use of guards on all exposed non-ducted fans.

INSTALLING THE PANEL FAN

Wall openings must be square and must be minimum 1/2" greater than the outside dimension of the panel fan housing, when recessed within the wall. Level and securely anchor the fan to the wall through holes pre-drilled in the mounting flange. Use the type, size and number of fasteners suitable to the unit size and wall construction. If the contractor removes ventilator parts, reassemble by placing all spacers, washers, nuts, bolts, fasteners and components exactly as they were prior to removal. Tighten and secure all fasteners.

Minimum Clearance Between Fan and Shutter – Figure 2

Model	Dimension C (Inches)												
	10	12	14	16	18	20	24	30	36	42	48	54	60
P	4	4	-	4	4	5	5	-	-	-	-	-	-
BX	-	4	4	4	4	4	4	-	-	-	-	-	-
BC/BLL/BCH	-	-	-	-	-	-	6	6	6	6	7	7.5	7.5
BHM/BHH	-	-	-	-	-	-	6	6	6	6	7	7	7

Figure 1: Rear Guard

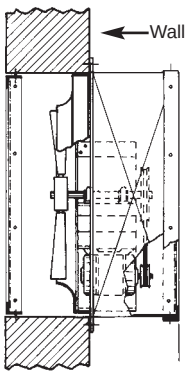


Figure 2: Wall Sleeve

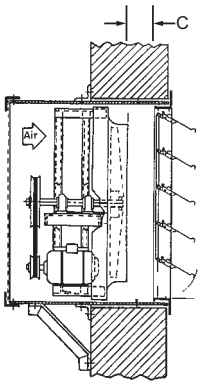


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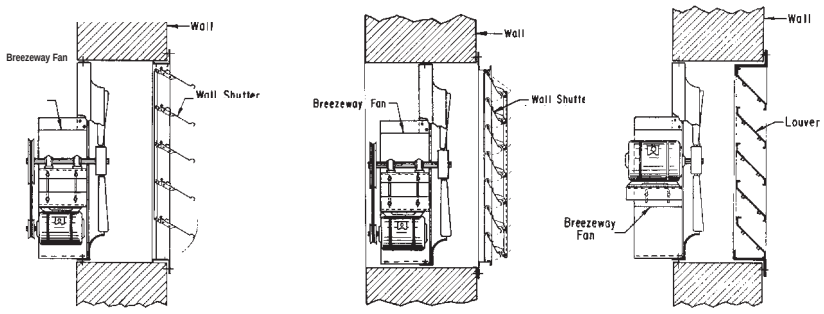
Figure 3: Typical Mounting Arrangements



Wall Shutter Recess Mounting

Wall Shutter Surface Mounting

Louver

⚠CAUTION ***Follow all local electrical, safety and building codes, the provisions of the National Electrical Code and the Occupational Safety and Health Act.***

POSITIONING AND RUNNING POWER LINES

Power is normally brought from within the building through proper conduit lines to the wall opening, and in turn to the (disconnect switch, if furnished) motor.

When power lines are brought up to the unit, provide a generous amount of slack to allow for motor adjustments and to permit movement of motor for belt tension adjustments. Ground motor adequately and securely. Protect power lines from sharp objects. Do not kink power line or permit it to contact hot surfaces, chemicals, grease or oil. Use only UL recognized electrical parts, rated for proper voltage, load and environment.

INSTALLING THE WALL SHUTTER

When required, level and fasten the wall shutter through the mounting holes provided in the shutter mounting flange. Consult Figure 1 for the proper mounting arrangements. Secure the shutter to the wall opening without undue twisting which may distort the frame. Check for free operation. If shutters are motor operated type, ascertain the proper voltage is present on motor terminals.

The fan is now ready for service.

Start-Up and Operation

Carefully inspect the unit before start-up. All motor bearings should be properly lubricated and all fasteners should be securely tightened. Rotate propeller by hand to insure free movement.

⚠CAUTION ***Before placing hand on impeller or belts, lock out power source. Check all set-screws and keys. Tighten when necessary.***

BELT TENSION AND PULLEY ALIGNMENT

Check condition of belts and the amount of tension prior to start-up. DO NOT overtighten, as bearing damage will occur.

Recommended belt tension should permit deflection of 1/64" per inch of span on each side of belt measured halfway between pulley centerline. Exercise extreme care when adjusting belts so as not to misalign the pulleys. Any misalignment will cause a sharp reduction in belt life an produce squeaky, annoying noises. On units equipped with two groove pulleys, adjust all belts with equal tension.

⚠CAUTION ***Whenever belts are removed or installed, never force belts over pulleys without loosening motor first, to relieve belt tension.***

Make sure inlets and approaches to the unit are free from obstruction. To assure maximum air movement, make sure adequate supply air is available.

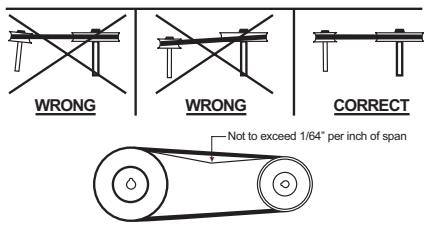
Before putting fan into operation, complete the following check list:

a. Turn off and LOCK OUT power source.

b. Make sure installation is in accordance with manufacturer's instructions.

c. Check and tighten all fasteners.

Figure 4: Pulley Alignment



d. Spin propeller to see if rotation is free.

e. Check all set-screws and keys: tighten if necessary.

f. Torqued set screws have a colored Torque Seal mark indicating the correct torque has been applied.

g. Check belt or direct drive coupling for alignment (use recommended belt tension gauges).

h. Check belt for proper sheave selection.

i. Make sure there is no foreign or loose material in ductwork leading to and from fan or in the fan itself.

j. Properly secure all safety guards.

k. Secure all access doors to fan and ductwork.

l. Check line voltage with motor nameplate.

m. Check wiring.

⚠CAUTION ***(On single phase motors, the terminal block must be set up in accordance with the nameplate instructions and/or wiring diagram. This set up must match the line voltage. If the motor is multi-speed or multi-voltage, the winding leads must be grouped and connected as shown on the motor wiring diagram. The line voltage must correspond with proper grouping of motor leads. The wiring diagram must be followed explicitly or serious motor or starter damage will occur.)***

The fan has been checked at the factory prior to shipment for mechanical noises. If mechanical noises should develop:

a. Check rotating components for adequate clearance.

b. Check proper belt tension and pulley alignment.

c. Check installation and anchoring.

d. Check fan bearings.

Switch on electrical supply and allow fan to reach full speed. Check carefully for:

1. Correct rotation of the impeller.

⚠CAUTION ***Incorrect rotation overloads motor severely and results in serious motor damage. To change rotation of three phase units, interchange any 2 of the 3 line leads. On single phase units, change the terminal block set-up following the wiring diagram on the motor.***

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2. Check motor and bearing temperatures for excessive heat against the manufacturer's recommendations.

⚠ CAUTION ***Use care when touching the exterior of an operating motor. Modern motors normally run hot. They are designed to operate at higher temperatures. This is a normal condition but they may be hot enough to be painful or injurious to the touch.***

If any problem is indicated, TURN OFF POWER TO UNIT IMMEDIATELY. Lock out the electrical supply, check carefully for the cause of the trouble and correct as needed. Even if the fan appears to be operating satisfactorily, shut down after a brief period and check all fasteners, set-screws and keys for tightness.

During the first eight (8) hours of operation, check the fan periodically for excessive vibration or noise. At this time, also check motor input current and motor bearing temperatures to insure that they do not exceed manufacturer's recommendations. After eight hours of satisfactory operation, shut down the fan and lock out the electrical power to check the following items and adjust if necessary:

a. All set-screws, keys and fasteners.

b. Drive coupling alignment.

c. Belt alignment.

d. Belt tension.

SUPPLY APPLICATIONS - FIELD MODIFICATIONS (BHM/BHH ONLY)

To modify to the exhaust supply, propeller must be "flipped" so that blade leading edge is closest to the motor.

SPECIAL PURPOSE SYSTEMS

Explosive, corrosive, high temperatures, etc., may require special construction, inspection and maintenance. It is necessary to observe the fan manufacturer's recommendations and limitations concerning the type of material to be handled by the fan and its application to special conditions.

Maintenance

Do not attempt maintenance on fan until the electrical supply has been completely disconnected. If a disconnect switch has not been provided, remove all fuses from the circuit and lock the fuse panel so they cannot accidentally be replaced.

Lubrication is a primary maintenance responsibility. Check all bearings periodically. Inspect belts for tightness. If the fan is installed in a corrosive or dirty atmosphere, periodically clean the impeller, inlet and other moving parts.

FAN SHAFT LUBRICATION

Fan shaft bearing pillow blocks are factory greased eliminating the need for greasing initially. Follow the lubricating schedule recommended by the factory. When required, apply grease while the shaft is rotating. This practice should not supersede any safety considerations.

⚠ CAUTION ***Use low pressure grease guns only. High pressure guns tend to blow out or unseat bearing seals, leaving the bearing open to collect grime, dust and foreign particles.***

LUBRICATION SCHEDULE

a. Under average conditions where ambient temperatures do not exceed 120°F, lubrication is required 1 to 2 times a year.

b. Under dirt laden atmospheres or where there is a temperature range of 120°F to 150°F, lubrication is required from 3 to 6 times a year.

c. Under extreme temperature conditions and extremely dirty atmospheres, lubrication should be at least once or twice a month.

Recommended Lubricants

Manufacturer	Product	Temp. Range
BP	LG-#P-1	Below 32°F (0°C)
Gulf	Gulfcrown EP-1	
Imperial Oil	Unirex EP-1	
Shell	Alvania R-1	
BP	Energrease, MPMK11	32°F to 150°F (0°C to 66°C)
Gulf	Gulfcrown EP-2	
Imperial Oil	Unirex EP-2	
Shell	Alvania R-3	
Sun Oil	Sun Prestige 42	
Texaco	Regal AFB2	

MOTOR LUBRICATION

In general, standard motors are furnished with prelubricated, sealed-for-life ball bearings which require no lubrication for 7 to 10 years of normal service. Where motors have been ordered with greasable bearings, these bearings are factory lubricated and require no attention for one year under normal conditions. If grease relief fittings are provided, remove them when performing maintenance to allow grease to flow out. Whenever possible, apply grease while the motor is running. This practice should not supersede any safety considerations. DO NOT OVERGREASE, as most lubricants deteriorate motor windings, thereby reducing motor life.

Hidden Danger

In addition to the normal dangers of rotating machinery, fans present an additional hazard in their ability to suck in not only air, but loose material as well. Solid objects can pass through the fan and be discharged by the impeller as potentially dangerous projectiles. Therefore, screen intake to ductwork, whenever possible, to prevent the accidental entrance of solid objects. Never open access doors to a duct system with the fan running.

When starting the fan for the first time, completely inspect the ductwork and interior of the fan (with power locked off), to make certain there is no foreign material which can be sucked into or blown through the ductwork.

Guards

All fans have moving parts which require guarding in the same way as other moving machinery.

Where the fan is accessible to untrained personnel or the general public, use maximum safety guards, even at the cost of some performance loss. Unprotected fans located less than 7' above the floor also require guarding as specified in the Occupational Safety and Health Act (OSHA).

PennBarry recommends the use of guards on all exposed nonducted fans, ceiling and wall mounted.

Troubleshooting Checklist

Symptom	Possible Cause(s)	Corrective Action
Excessive noise	1. Defective or loose motor bearings	1. Replace motor with same frame size, RPM, HP
	2. Ventilator base not securely anchored	2. Reset properly
	3. Loose or unbalanced wheel/propeller	3. Tighten screws, remove build-up, balance wheel/propeller
	4. Misaligned pulleys or shaft	4. correct alignment
	5. Loose or damaged wheel/propeller	4. Replace wheel/propeller
	6. Wheel running in wrong direction	6. Reverse direction
Fan inoperative	1. Blown fuse or open circuit breaker	1. Replace fuses or circuit breaker
	2. Loose or disconnected wiring	2. Shut off power and check wiring for proper connections
	3. Defective motor	3. Repair or replace motor
	4. Broken belts	4. Replace belts
Insufficient airflow	1. Clogged filters	1. Clean filters
	2. Operation in wrong direction	2. Correct rotation of propeller
	3. Insufficient make-up air direction	3. Add make-up fan or louver opening
Motor overheating	1. Belt slippage	1. Adjust tension or replace belts
	2. Overvoltage or under voltage	2. Contact power supply company
	3. Operation in wrong direction	3. Reverse direction of motor
	4. Fan speed too high	4. Slow down fan by opening variable pitch pulley on motor shaft
	5. Incorrect motor (service factor 1.0, low ambient temperature)	5. Replace motor with correct open, NEMA service factors (1.15 or higher) with 40 degrees ambient
	6. Undersized motor	6. Check motor ratings with catalog speed and air capacity chart

Note: Care should be taken to follow all local electrical, safety and building codes. Provisions of the National Electric Code (NEC), as wells as the Occupational Safety and Health Act (OSHA) should be followed.

All motors are checked prior to shipment. If motor defects should develop, prompt service can be obtained from the nearest authorized service station of the motor manufacturer while under warranty. Exchange, repair or replacement will be provided on a no charge basis if the motor is defective within the warranty period. The PennBarry representative in your area will provide a name and address of an authorized service station if requested. WARNING: Motor guarantee is void unless overload protection is provided in motor wiring circuit.

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Parts Replacement

If replacing parts, do so with properly selected components which duplicate the original parts correctly. Incorrectly sized shafts, belts, pulleys, impellers, etc., can damage the fan.

Typical Parts List

1. Panel
2. Venturi Orifice
3. Fan Blade (Cast Aluminum or Fabricated Steel)
4. Ball Bearing Motor
5. Structural Supports
6. Motor Mounting Plate
7. Fan Shaft and Bearings (Belt Drive Only)
8. Belt and Pulleys (Belt Drive Only)

Figure 5: Direct Drive

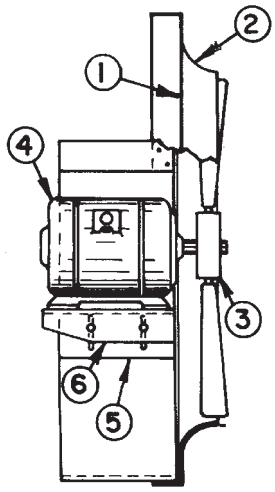
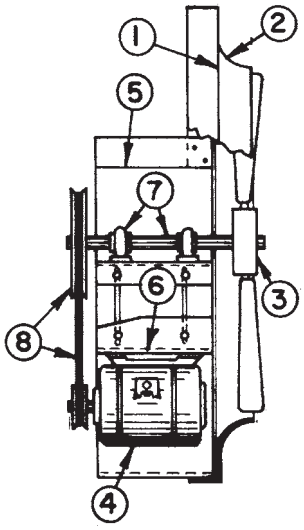


Figure 6: Belt Drive



Wall Mounting Sleeve Assembly

Figure 7

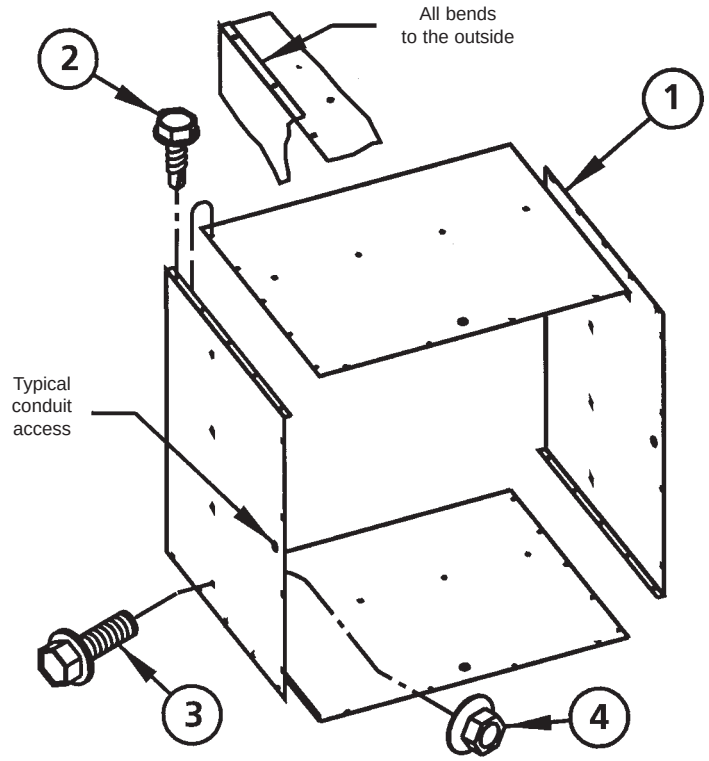


Table 2: Parts List

Item	Quantity	Description
1	4	Wall Sleeve Panel
2	*	1/4-20 X 3/4 Self Tapping Screw
3**	*	1/4-20 X 3/4 Whiz Bolt
4**	*	1/4-20 Whiz Nut

NOTES:

1. Make sure all bends are to the outside.

2. Use caulk to seal all seams.

* 3. Varies by model side.

** 4. This hardware is used to attach the fan (not illustrated) into wall sleeve.

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Weathershield Assembly

Figure 8

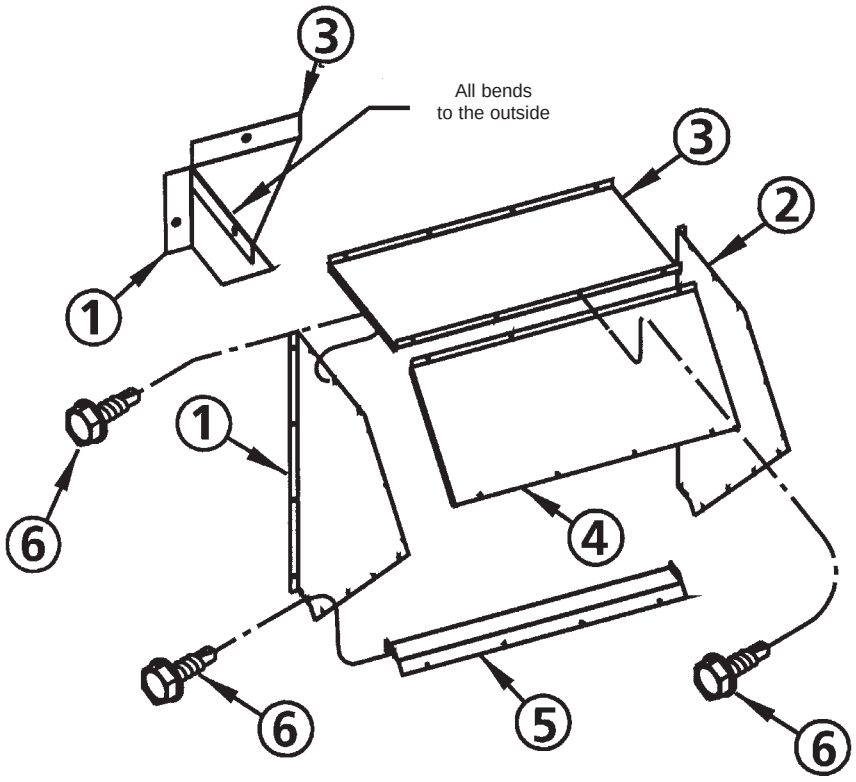

Table 3: Parts List

Item	Quantity	Description
1	1	Weather Cover Side (LEFT)
2	1	Weather Cover Side (RIGHT)
3	1	Weather Cover Top #1
4	1	Weather Cover Top #2
5	1	Weather Cover Bottom
6	*	1/4-20 X 3/4 Self Tapping Screw

NOTES:

1. Make sure all bends are to the outside.

2. Use caulk to seal all seams.

* 3. Varies by model side.

2 Piece Wall Mounting Sleeve/Weather Shield Guard Assembly 54" & 60"

Figure 9

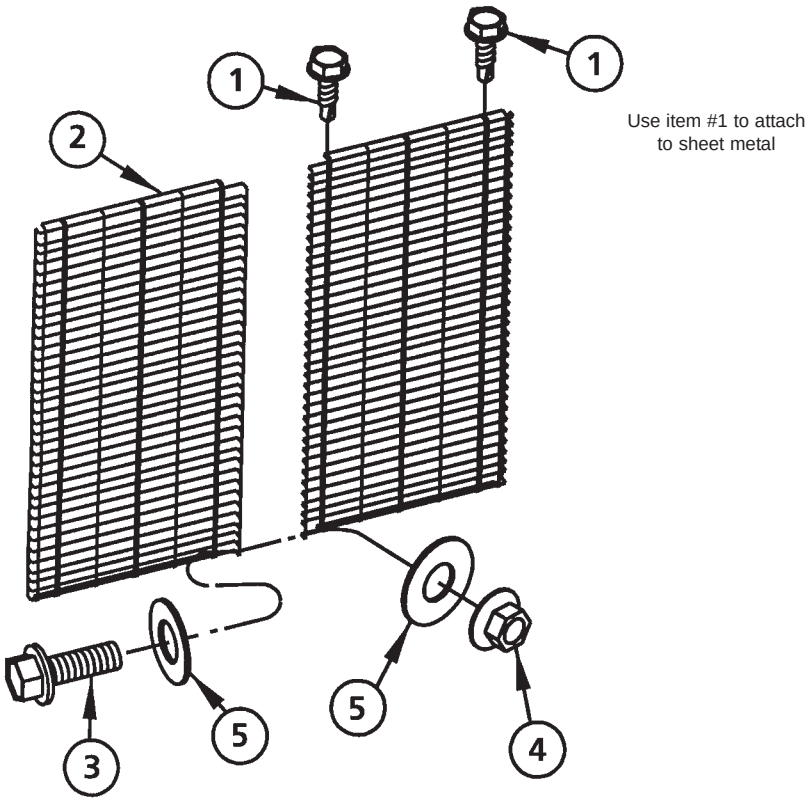

Table 4: Parts List

Item	Quantity	Description
1	40	1/4-20 X 3/4 Self Tapping Screw
2	2	Screen Guard
3*	5	3/8-16 X 1" Whiz Bolt
4*	5	3/8-16 Whiz Nut
5*	10	.390 X 1.875 Diameter Washer

NOTES:

* 1. Equally space hardware connecting both halves of guard.

2. Guards 24 thru 48 are 1 piece with no assembly required.

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Rear/Front Guard Assembly

Figure 10

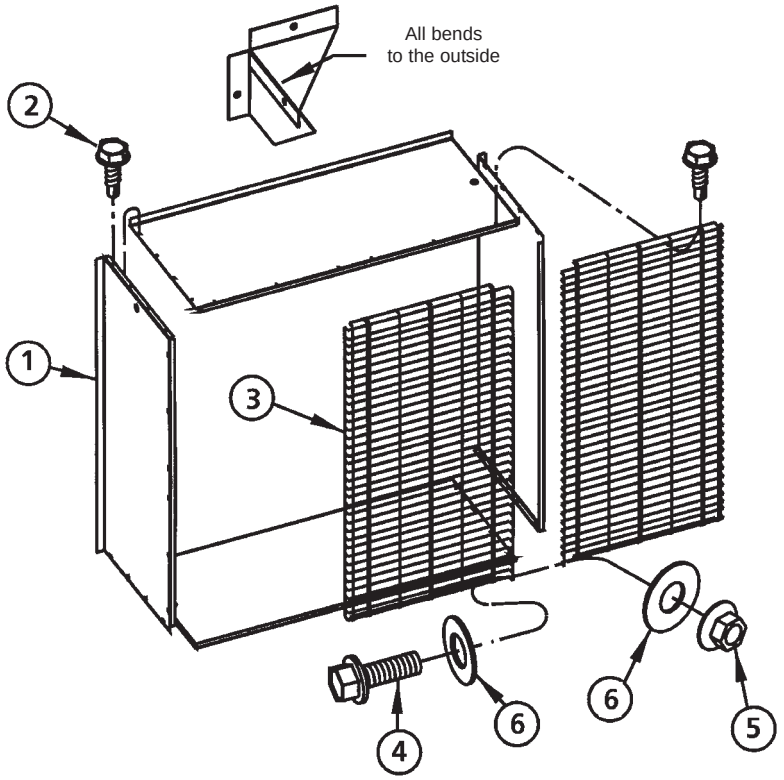

Table 5: Parts List

Item	Quantity		Description
	Rear	Front	
1	4	4	Guard Panel
2	*	*	1/4-20 X 3/4 Self Tapping Screw
3	**	**	Screen Guard
4***	5	5	3/8-16 X 1" Whiz Bolt
5***	5	5	3/8-16 Whiz Nut
6***	10	10	.390 X 1.875 Diameter Washer

NOTES:

1. Assemble the sheet metal parts first then attach the screen second.
2. Make sure that all bends are to the outside.
3. Use caulk to seal all seams.

* 4. Varies by model size.

** 5. Guards 24 thru 48 are 1 piece with no assembly required. 54 & 60 are 2 pieces.

*** 6. Equally space hardware connecting both halves of guard (54 & 60).

Limited One Year Warranty

What Products Are Covered
PennBarry Fans and Ventilators (each, a "PennBarry Product")

One Year Limited Warranty For PennBarry Products
PennBarry warrants to the original commercial purchaser that the PennBarry Products will be free from defects in material and workmanship for a period of one (1) year from the date of shipment.

Exclusive Remedy
PennBarry will, at its option, repair or replace (without removal or installation) the affected components of any defective PennBarry Product; repair or replace (without removal or installation) the entire defective PennBarry Product; or refund the invoice price of the PennBarry Product. In all cases, a reasonable time period must be allowed for warranty repairs to be completed.

What You Must Do
In order to make a claim under these warranties:

1. You must be the original commercial purchaser of the PennBarry Product.
2. You must promptly notify us, within the warranty period, of any defect and provide us with any substantiation that we may reasonably request.
3. The PennBarry Product must have been installed and maintained in accordance with good industry practice and any specific PennBarry recommendations.

Exclusions
These warranties do not cover defects caused by:

1. Improper design or operation of the system into which the PennBarry Product is incorporated.
2. Improper installation.
3. Accident, abuse or misuse.
4. Unreasonable use (including any use for non-commercial purposes, failure to provide reasonable and necessary maintenance as specified by PennBarry, misapplication and operation in excess of stated performance characteristics).
5. Components not manufactured by PennBarry.

Limitations
1. In all cases, PennBarry reserves the right to fully satisfy its obligations under the Limited Warranties by refunding the invoice price of the defective PennBarry Product (or, if the PennBarry Product has been discontinued, of the most nearly comparable current product).
2. PennBarry reserves the right to furnish a substitute or replacement component or product in the event a PennBarry Product or any component of the product is discontinued or otherwise unavailable.
3. PennBarry's only obligation with respect to components not manufactured by PennBarry shall be to pass through the warranty made by the manufacturer of the defective component.

General
The foregoing warranties are exclusive and in lieu of all other warranties except that of title, whether written, oral or implied, in fact or in law (including any warranty of merchantability or fitness for a particular purpose).

PennBarry hereby disclaims any liability for special, punitive, indirect, incidental or consequential damages, including without limitation lost profits or revenues, loss of use of equipment, cost of capital, cost of substitute products, facilities or services, downtime, shutdown or slowdown costs.

The remedies of the original commercial purchaser set forth herein are exclusive and the liability of PennBarry with respect to the PennBarry Products, whether in contract, tort, warranty, strict liability or other legal theory shall not exceed the invoice price charged by PennBarry to its customer for the affected PennBarry Product at the time the claim is made.

Inquiries regarding these warranties should be sent to: PennBarry, 1401 North Plano Road, Richardson, TX 75081.

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